

# EXHIBIT 1

**UNITED STATES DISTRICT COURT  
DISTRICT OF MASSACHUSETTS**

In re PEGASYSTEMS INC. SECURITIES  
LITIGATION

No. 1:22-cv-11220-WGY

REPORT ON MARKET EFFICIENCY AND DAMAGES METHODOLOGY

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## **I. SCOPE OF PROJECT AND REPORT**

1. Robbins Geller Rudman & Dowd LLP, Lead Counsel for Lead Plaintiffs, asked me to determine whether the common stock of Pegasystems Inc. (“Pega” or the “Company”) traded in an efficient market during the period from 16 June 2020 through 9 May 2022, inclusive (the “Class Period”).<sup>1</sup>
2. Counsel also asked me to determine if there is a methodology that is consistent with Lead Plaintiffs’ theory of liability that can be used to compute Section 10(b) damages commonly for all Class members.<sup>2</sup>
3. To make these determinations, I analyzed the market for Pega stock, the price behavior of the stock, and the factors that are generally accepted indicators of market efficiency for a publicly traded security. I examined Company press releases, conference call transcripts, equity analyst reports, news articles, SEC filings, daily prices of the stock, trading volume, the performance of the overall stock market, and the performance of Pega’s industry sector, as well as other pertinent data and documents. I also read the Lead Plaintiffs’ Consolidated Amended Complaint for Violations of the Federal Securities Laws, filed 18 October 2022 (the “Complaint”), and the Court’s Memorandum and Order, filed 24 July 2023 (“MTD Order”).<sup>3</sup> Exhibit-1 hereto lists the documents I considered in preparing this report and arriving at the opinions expressed herein.
4. This report presents my methodology, findings, and conclusions.

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<sup>1</sup> Lead Counsel has also asked me to determine whether the common stock of Pega traded in an efficient market during the period from 16 June 2020 through 15 September 2022, inclusive (the “Examination Period”).

<sup>2</sup> Section 10(b) damages are compensable losses for Class members who have claims pursuant to Section 10(b) of the Securities Exchange Act of 1934 (the “Exchange Act”) and Securities and Exchange Commission (“SEC”) Rule 10b-5 adopted thereunder (collectively, “Section 10(b)”). “Lead Plaintiffs” of “Plaintiffs” are Lead Plaintiffs Central Pennsylvania Teamsters Pension Fund - Defined Benefit Plan, Central Pennsylvania Teamsters Pension Fund - Retirement Income Plan 1987, and Construction Industry Laborers Pension Fund.

<sup>3</sup> I understand that in the MTD Order, the Court granted in part and denied in part Defendants’ motion to dismiss. I understand that certain statements alleged in the Complaint to have been fraudulent misstatements have been deemed nonactionable (MTD Order, pp. 21-22).

5. My work in this matter is ongoing. I reserve the right to amend, refine, or supplement my analyses and opinions in the event that I become aware of additional information, evidence, arguments, or analyses that bear on my work in this matter.

## II. CREDENTIALS

6. I am an Associate Professor of Finance at Babson College, and the founder and president of Crowninshield Financial Research, Inc., a financial economics consulting firm.
7. I hold a Ph.D. in Economics from Yale University, a Master of Philosophy degree in Economics from Yale University, a Master of Arts degree in Economics from Yale University, and a Bachelor of Arts degree in Economics from Pomona College. I also hold the Chartered Financial Analyst (“CFA”) designation, granted by the CFA Institute.
8. At Babson College, I have taught undergraduate and MBA-level courses in Capital Markets, Investments, Equity Analysis, Fixed Income Analysis, Financial Management, Risk Management, Quantitative Methods, and Security Valuation. I have also taught executive courses on investments and corporate financial management for numerous corporations. The other courses I have taught are listed in my curriculum vitae, which is attached as Exhibit-2.
9. I have held the Chair in Applied Investments at Babson College and served as the Director of the Stephen D. Cutler Investment Management Center, a research and education center dedicated to the study and teaching of investments and capital markets.
10. Prior to joining the faculty at Babson College, I taught at Boston University. Preceding my academic posts, I was an Economist at the Federal Reserve Bank of Atlanta where my primary responsibilities were to monitor financial markets, analyze proposed regulation, and advise the Bank President in preparation for his participation in meetings of the Federal Open Market Committee – the government body responsible for monetary policy in the United States (“U.S.”).
11. I have published extensively in the field of finance. My finance articles have appeared in the *Atlanta Federal Reserve Bank Economic Review*, *Derivatives Quarterly*, *Derivatives Weekly*, *The Engineering Economist*, *The Journal of Risk*, *The American Bankruptcy Institute Journal*, *The Journal of Financial Planning*, *The Journal of Forensic Economics*, *Managerial Finance*, *Risk Management*, *Primus*, and *The Review of Quantitative Finance*

*and Accounting*. I am the author of *Finance and Accounting for Project Management*, published by the American Management Association. I wrote two chapters in the book *The Portable MBA in Finance and Accounting* – one on corporate financial planning and the other on risk management. I have presented research at the annual conventions of the American Finance Association, the Academy of Financial Services, the Multinational Finance Society, the Financial Management Association, the Taxpayers Against Fraud Education Fund Conference, and the International Conference on Applied Business Research. I also co-authored papers that have been presented at the Eastern Finance Association meetings, the Midwestern Finance Association meetings, and the Boston Area Finance Symposium. A list of all the publications I authored in the past ten years can be found in my curriculum vitae, which is attached as Exhibit-2.

12. I have been selected to review papers for numerous finance journals and conferences. Specifically, I have reviewed finance textbook manuscripts for Prentice-Hall, Elsevier, Blackwell, and Southwestern Publishing. I have been quoted on matters relating to finance and investments in *The Wall Street Journal*, *The Washington Post*, *The New York Times*, *The Financial Times*, *The Boston Globe*, and *Bloomberg News*. Further, my research relating to financial analysis and valuation has been discussed in *The Wall Street Journal*, *Bond Buyer*, and *Grant's Municipal Bond Observer*.
13. I am a member of the American Finance Association, the Financial Management Association, the North American Case Research Association, the National Association of Forensic Economics, the CFA Institute, and the CFA Society Boston. I have served as a member of the CFA Society Boston education committee and ethics subcommittee. I also served on the Fixed Income Specialization Examination Committee of the CFA Institute.
14. The CFA designation is the premier credential for financial analysts worldwide. In order to receive this credential, applicants must pass a series of three exams covering such topics as economics, equity analysis, financial valuation, business analysis, quantitative methods, investment analysis, portfolio management, risk management, financial accounting, and ethical and professional standards. For over ten years I taught in the Boston University CFA Review Program and the CFA Society Boston Review Program – two of the leading review programs that prepared candidates for the CFA exams. In both of these programs I taught candidates at the most advanced level of the CFA curriculum.

15. In addition to my teaching, research, and academic community responsibilities, I practice extensively as a financial consultant. My clients are primarily law firms that are prominent in securities litigation. Past clients also include the SEC, the Internal Revenue Service, the Attorney General of the State of Illinois, and the National Association of Securities Dealers. As an expert in financial economics, over the past 25 years, I have conducted analyses and presented opinions related to financial markets, valuation, and damages in more than 200 cases. Exhibit-3 lists my prior testimony over the past four years.
16. I am the sole owner of the consulting firm Crowninshield Financial Research, Inc., which receives compensation for the work performed by me and the staff who assist me. My firm is being compensated at a rate of \$995 per hour for my work, and a range of lower rates for analysts and other personnel who are assisting me on this case. My compensation is not contingent on my findings or on the outcome of this matter.

### III. CONCLUSIONS

17. Pega stock traded in an efficient market over the course of the Class Period.
18. I examined the generally accepted and widely used indicia of market efficiency set forth in *Cammer v. Bloom*, 711 F. Supp. 1264, 1273 (D.N.J. 1989) (“*Cammer*”) and *Krogman v. Sterritt*, 202 F.R.D. 467, 474-78 (N.D. Tex. 2001) (“*Krogman*”). Consistent with financial economic principles and empirical research, these factors are probative indicators of market efficiency. Courts in the First Circuit have accepted and applied these factors as dispositive evidence of market efficiency.<sup>4</sup> Pega stock satisfied all of the *Cammer* and *Krogman* factors throughout the Class Period.
19. One of the *Cammer* factors is empirical evidence of the subject security demonstrating market efficiency. Pega stock satisfied this factor test with a high degree of statistical certainty. Statistical analysis examining the empirical behavior of Pega stock proves that there was a cause-and-effect relationship between the release of Company-specific information and movement in the Pega stock price. Pega stock responded to Company-specific information, which is the essence of market efficiency.

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<sup>4</sup> See, e.g., *Levy v. Gutierrez*, 448 F. Supp. 3d 46 (D.N.H. 2019) and *In re Aveo Pharms., Inc. Sec. Litig.*, Civil Action No. 13-11157 (D. Mass. Nov. 14, 2017).



20. Based on the foregoing, I conclude that Pega stock traded in an efficient market throughout the Class Period.<sup>5</sup>
21. Section 10(b) damages in this matter can be computed for all Class members using a common methodology that is consistent with Plaintiffs' theory of liability. Specifically, the out-of-pocket damage model, which is used in virtually all Section 10(b) class action securities cases, is appropriate and applicable here.

#### IV. FACTUAL BACKGROUND

##### A. About the Company

22. Throughout the Class Period, Pega was in the business of developing, selling, licensing, hosting, and supporting software solutions that helped organizations across industries to better engage with its customers and automate workflow.<sup>6</sup> The Company's target clients were government agencies and global enterprises.<sup>7</sup>
23. The Company primarily generated revenues by selling its software through subscription arrangements and consulting services.<sup>8</sup> Pega measured its performance through performance metrics including: 1) Annual Contract Value ("ACV") and 2) Remaining Performance Obligations ("Backlog").<sup>9</sup>

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<sup>5</sup> Based on an analysis of the *Cammer* and *Krogman* factors for the Examination Period, including the empirical *Cammer* factor, I conclude that Pega stock traded in an efficient market throughout the Examination Period.

<sup>6</sup> Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2020, filed 17 February 2021, p. 5; Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2021, filed 16 February 2022, p. 4; and Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2022, filed 15 February 2023, p. 4.

<sup>7</sup> Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2020, filed 17 February 2021, p. 7 and Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2021, filed 16 February 2022, p. 7.

<sup>8</sup> Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2020, filed 17 February 2021, p. 27; Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2021, filed 16 February 2022, p. 28; and Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2022, filed 15 February 2023, p. 28.

<sup>9</sup> Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2020, filed 17 February 2021, pp. 25-26; Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2021, filed 16 February 2022, pp. 27-28; and Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2022, filed 15 February 2023, pp. 26-27.

24. For fiscal year (“FY”) 2020, FY 2021, and FY 2022, the Company reported revenues of \$1.02 billion, \$1.21 billion, and \$1.32 billion, respectively.<sup>10</sup> For FY 2020, 2021, and 2022, the Company reported net losses of \$61.37 million, \$63.04 million, and \$345.58 million, respectively.<sup>11</sup>

## **B. About Pega Stock**

25. Throughout the Class Period, the Company’s stock traded on the Nasdaq exchange under the ticker symbol PEGA.<sup>12</sup>
26. Pega’s stock price at the start of the Class Period stood at \$97.47 per share, according to price data obtained from the Center for Research in Security Prices (“CRSP”), a reliable data source that is widely used by academic researchers and investment professionals. The closing stock price peaked during the Class Period at \$146.71 per share on 12 February 2021. By the close of trading on 10 May 2022, the first trading day following the end of the Class Period, Pega’s stock price had fallen to \$52.25 per share – a decline of \$94.46 per share or 64.39% from the Class Period high. By the close of trading on 16 September 2022, the day of the alleged final corrective disclosure, Pega’s stock price had fallen to \$37.85 per share – a decline of \$108.86 per share or 74.20% from the Class Period high. Pega stock prices during the Class Period are presented in Exhibit-4.
27. At the start of the Class Period, Pega’s market capitalization, the aggregate value of all outstanding shares, was \$7.81 billion.<sup>13</sup> At its Class Period peak on 12 February 2021, Pega’s market capitalization was \$11.87 billion. At the close of trading on 10 May 2022, the Company’s market capitalization was \$4.28 billion, a decline of \$7.59 billion or 63.98% from the Class Period high. By the close of trading on 16 September 2022, the Company’s market capitalization was \$3.10 billion, a decline of \$8.77 billion or 73.87% from the Class Period high.

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<sup>10</sup> Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2022, filed 15 February 2023, p. 39.

<sup>11</sup> Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2022, filed 15 February 2023, p. 39.

<sup>12</sup> Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2020, filed 17 February 2021, p. 23; Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2021, filed 16 February 2022, p. 25; and Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2022, filed 15 February 2023, p. 24.

<sup>13</sup> Shares outstanding data obtained from Company SEC filings.

**V. SUMMARY OF PLAINTIFFS' ALLEGATIONS**

28. On 29 May 2020, Appian Corporation (“Appian”), a competitor of Pega, filed a lawsuit against the Company (the “Virginia Action”). The lawsuit alleged that:

“Over the course of many years, Pegasystems has engaged in an unlawful campaign of corporate espionage against Appian ... Involving personnel at Pegasystems up to and including Pegasystems’ CEO and Founder, Alan Trefler, and other high-ranking Pegasystems executives, and assisted at least by Zou, Pegasystems’ unlawful schemes have involved stealing Appian’s trade secrets and confidential information and then using them to damage Appian’s business and reputation, and to steal Appian’s customers and potential customers.”

*Appian Corporation v. Pegasystems Inc.*, et al., Civil Action No. 2020-07216, Circuit Court of Fairfax County, Virginia, 29 May 2020.

29. Plaintiffs allege that Defendants, fully aware of their involvement in the actions leading to the Virginia lawsuit, intentionally withheld information about the litigation, provided false assurances to investors that Appian’s claims lacked merit, and deceptively pledged to never engage in the unauthorized use of trade secrets.<sup>14</sup> Specifically, the Complaint alleges:

“Defendants’ false and misleading statements and omissions included: (a) statements touting Pega’s competition and sales and marketing practices, while failing to disclose, *inter alia*, it was relying on corporate espionage to gain a competitive advantage ...; (b) statements concerning Pega’s competitors’ intellectual property rights and that infringement claims by unnamed competitors could arise at some indeterminate point, while concealing, *inter alia*, the existence of the Virginia Action and evidence of Pega’s egregious scheme to misappropriate Appian’s trade secrets ...; (c) statements that Appian’s claims lacked merit and any damages were not supported, while failing to disclose, *inter alia*, Appian’s liability and damages claims were well-supported ...; (d) statements regarding Pega’s Code and ethical practices, which failed to disclose, *inter alia*, Pega’s egregious corporate espionage and flagrant violations of Pega’s own guidelines ...; and (e) statements concerning defendants’ compliance with the federal securities laws, which failed to disclose that, *inter alia*, Pega’s Forms 10-K and 10-Q were materially misleading and contained false financial statements ....”

**Complaint, ¶120.**

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<sup>14</sup> Complaint, V. A, B, C.

30. Plaintiffs contend that the truth began to be revealed on 16 February 2022, when Pega filed its Form 10-K, discussing the Virginia Action and disclosing that Appian was seeking around \$3 billion in damages due to Pega's alleged misuse of Appian's trade secrets.<sup>15</sup>
31. Plaintiffs allege that Defendants subsequently continued to mislead investors by providing false assurances that Appian's claims were "unsupported" and "without merit."<sup>16</sup>
32. Plaintiffs contend that corrective information concerning Defendants' false and materially misleading statements and omissions was released to the market on 9 May 2022, when the Company announced that the jury in the Virginia Action had rendered a verdict in favor of Appian, awarding more than \$2 billion in damages.<sup>17</sup>

"After the market closed on May 9, 2022, Pega filed a report on Form 8-K announcing the jury in the Virginia Action had rendered a unanimous verdict against Pega, finding it had violated the VUTSA and VCCA, awarding Appian \$2,036,860,045 in damages and entitling Appian to recover attorney's fees and other relief."

**Complaint, ¶244.**

33. Subsequently, Pega moved to set aside the verdict. However, on 16 September 2022, the court denied the motion. Pega announced that in addition to the \$2,036,860,045 damages, the Company would have to pay "post judgment interest on Appian's damages at the annual rate of 6% (accruing from May 9, 2022), attorney's fees in the amount of \$23,615,461.34, and costs in the amount of \$3,780.07, plus post judgment interest on the attorney's fees and costs at the annual rate of 6%, accruing from the date of judgment."<sup>18</sup>

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<sup>15</sup> Complaint, ¶243.

<sup>16</sup> Complaint, ¶243.

<sup>17</sup> Complaint, ¶244.

<sup>18</sup> Complaint, ¶247.

## VI. MARKET EFFICIENCY DEFINITION AND ASSESSMENT METHODOLOGY

### A. Efficient Market Defined

34. The definition of market efficiency set forth by Judge Alfred J. Lechner, Jr. in the seminal 1989 *Cammer v. Bloom* decision is often cited as a legal authority on the meaning of market efficiency and is consistent with the definition of informational efficiency generally accepted by the academic finance community:

“As relevant here, courts have permitted a rebuttable presumption of reliance in the case of securities traded in ‘efficient markets’ (i.e., markets which are so active and followed that material information disclosed by a company is expected to be reflected in the stock price).”  
*Cammer*, 711 F. Supp. at 1273.

35. In the *Cammer* case, Judge Lechner cited definitions offered by commentators Alan Bromberg and Lewis Lowenfels and by renowned financial economist and Nobel Laureate Eugene Fama:

“An efficient market is one which rapidly reflects new information in price.”

“Private Actions,” by Alan Bromberg et al., chapter 7 of *Bromberg and Lowenfels on Securities Fraud*, vol. 5, 2<sup>nd</sup> ed., Thomson Reuters, 2013, at § 7:484; see also *Cammer*, 711 F. Supp. at 1276 n.17 (citing Bromberg & Lowenfels, 4 *Securities Fraud and Commodities Fraud*, § 8.6 (Aug. 1988).

“A market in which prices always ‘fully reflect’ available information is called ‘efficient.’”

“Efficient Capital Markets: A Review of Theory and Empirical Work,” by Eugene Fama, *The Journal of Finance*, vol. 25, no. 2, 1970, cited in *Cammer*, 711 F. Supp. at 1280.

36. In his 1991 follow-up article titled “Efficient Capital Markets: II,” Professor Fama elaborated on this point and qualified the definition of market efficiency to conform to economic realities rather than the perfect ideal:

“I take the market efficiency hypothesis to be the simple statement that security prices fully reflect all available information. ... A weaker and economically more sensible version of the efficiency hypothesis says that

prices reflect information to the point where the marginal benefits of acting on information (the profits to be made) do not exceed the marginal costs.”  
**“Efficient Capital Markets: II,”** by Eugene Fama, *The Journal of Finance*, vol. 46, no. 5, 1991, p. 1575.

37. In his 1991 article on efficient markets, excerpted above, Professor Fama explained that with respect to the material public information that is rapidly incorporated into a security price in an efficient market, the cost and *a priori* expected benefit of seeking that information matters. Information announced to the public and broadly disseminated is less costly to acquire than is information that must be unearthed even if from public sources. Professor Fama’s description of an efficient market recognizes that the former is more likely to be absorbed into and reflected in a market price than the latter, as the expected benefit of acquiring the information must outweigh the expected cost.
38. Professor Fama and a group of preeminent economists described market efficiency and the state of the profession’s general understanding in an *amici curiae* brief that they submitted in 2014 to the U.S. Supreme Court in the *Halliburton II* case.<sup>19</sup> They explained that it is a widely accepted principle that security prices generally react to and reflect material public information, which is the essence of informational market efficiency. They explained this point, as follows:

“There is widespread debate about market efficiency among economists, and the signatories of this brief include participants with varying positions on that debate. It is critical, however, to be clear about what issues are in dispute – and what issues are not. Economists disagree about whether markets *perfectly* process information and how quickly they do so; about whether prices reflect the fundamental value of the underlying stock; ... and about whether it is possible to ‘beat the market’ by pursuing various investment strategies designed to exploit pricing anomalies. Such disagreements existed when *Basic [Inc. v. Levinson]*, 485 U.S. 224] was decided in 1988, and they exist today. But economists do *not* generally disagree about whether market prices respond to new material information.”  
**Brief of Financial Economists as Amici Curiae in Support of Respondents, in *Halliburton Co. v. Erica P. John Fund, Inc.*, Case No. 13-317 (U.S. Supreme Court), 5 February 2014, p. 3 (emphasis in original).**

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<sup>19</sup> See, e.g., *Halliburton Co. v. Erica P. John Fund, Inc.*, 573 U.S. 258 (2014) (“Halliburton II”).

39. The U.S. Supreme Court in the 1988 *Basic v. Levinson* decision focused on the same important characteristic at the heart of these definitions of market efficiency – that security prices react to and therefore reflect publicly available material information:

“The fraud on the market theory is based on the hypothesis that, in an open and developed securities market, the price of a company’s stock is determined by the available material information regarding the company and its business ... .”

*Basic, Inc. v. Levinson*, 485 U.S. 224, 241 (1988).

40. The U.S. Supreme Court’s 2013 *Amgen* decision reiterated the definition of market efficiency at the heart of the fraud-on-the-market principle, as follows:

“The fraud-on-the market premise is that the price of a security traded in an efficient market will reflect all publicly available information about a company ... .”

*Amgen, Inc. v. Connecticut Retirement Plans & Trust Funds*, 568 U.S. 455 (2013).

41. In its 2014 *Halliburton II* decision, the U.S. Supreme Court clarified definitively that the market efficiency definition relevant to a securities case is that the security at issue reacts to and therefore reflects material public information:

“Even the foremost critics of the efficient-capital-markets hypothesis acknowledge that public information generally affects stock prices. ... Debates about the precise *degree* to which stock prices accurately reflect public information are thus largely beside the point. ‘That the ... price [of a stock] may be inaccurate does not detract from the fact that false statements affect it, and cause loss,’ which is ‘all that *Basic* requires.’”

*Halliburton Co. v. Erica P. John Fund, Inc.*, 573 U.S. 258, 272 (2014) (emphasis in original; internal citations omitted).

“To recognize the presumption of reliance, the Court explained, was not ‘conclusively to adopt any particular theory of how quickly and completely publicly available information is reflected in market price.’ The Court instead based the presumption on the fairly modest premise that ‘market professionals generally consider most publicly announced material statements about companies, thereby affecting stock market prices.’”

*Halliburton Co. v. Erica P. John Fund, Inc.*, 573 U.S. 258, 272-73 (2014) (internal citations omitted).

42. An efficient market, as defined and discussed by *Cammer*, *Basic*, *Amgen*, *Halliburton II*, Bromberg and Lowenfels, Professor Fama, and other leading scholars, is a market in which publicly available information is incorporated into the price of a security such that the trading price reflects publicly available information with reasonable promptness. As precedent cases have recognized, market efficiency is relevant to a securities case because it addresses the question of whether false information (e.g., in the form of an alleged misrepresentation or omission) would likely have impacted the prices at which investors bought and sold securities, and upon which investors relied.
43. According to the preeminent economists who authored the *Halliburton II amici curiae* brief and whose view represent the widely accepted understanding in the finance profession, it would be an exception to a generally prevailing rule for a market for a publicly traded security to be informationally inefficient rather than efficient.

## **B. Indicators of Market Efficiency**

### **1. The *Cammer* Factors**

44. The *Cammer* opinion enumerates five factors that indicate whether the market for a security is efficient. As described below, economic rationales support each factor as an indicator of market efficiency. The five factors are 1) trading volume, 2) coverage by securities analysts, 3) number of market makers, 4) eligibility for Form S-3 registration, and 5) empirical evidence that the security price reacts to new, company-specific information.
45. Empirical research has confirmed that trading volume,<sup>20</sup> number of market makers, analyst coverage,<sup>21</sup> and high institutional ownership are indicative of market efficiency:

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<sup>20</sup> See, e.g., “Sophisticated Investors and Market Efficiency: Evidence from a Natural Experiment,” by Yong Chen et al., *Journal of Financial Economics*, vol. 138, no. 2, 2020, p. 333 (“Bai et al. (2016) present comprehensive evidence on the relation between liquidity and market efficiency. They show that firms with higher levels of liquidity (measured by share turnover) have higher price informativeness.”);

“Trading Volume and Cross-Autocorrelations in Stock Returns,” by Tarun Chordia and Bhaskaran Swaminathan, *The Journal of Finance*, vol. 55, no. 2, 2000, p. 913 (“Additional tests indicate that this effect is related to the tendency of high volume stocks to respond rapidly and low volume stocks to respond slowly to marketwide information.”)

<sup>21</sup> See, e.g., “Sophisticated Investors and Market Efficiency: Evidence from a Natural Experiment,” by Yong Chen et al., *Journal of Financial Economics*, vol. 138, no. 2, 2020, p. 323 (“Our findings confirm the role of sell-side analysts in providing valuable information to stock market participants and helping facilitate stock market efficiency.”);



“Consistent with the efficiency indicators used recently by the courts, the inefficient firms have lower mean trading volume, fewer market makers, lower analyst following, and lower institutional ownership (number and percentage) than efficient firms.”

“The Fraud-on-the-Market Theory and the Indicators of Common Stocks’ Efficiency,” by Brad Barber et al., *The Journal of Corporation Law*, 1994, p. 302.

46. Published peer-reviewed research that I conducted (with Miguel Villanueva, Ph.D.) found that the *Cammer* factors are generally dispositive indicators of stock price reactivity to information and therefore informational market efficiency. We explained that:

“Our findings that the *Cammer/Krogman* factors are generally dispositive of reactivity supports the widespread use by courts of the *Cammer/Krogman* factors as indicia of market efficiency.”

“Stock Price Reactivity to Earnings Announcements: The Role of the *Cammer/Krogman* Factors,” by Miguel Villanueva and Steven Feinstein, *Review of Quantitative Finance and Accounting*, vol. 57, no. 1, 2021, p. 233.

47. Consistent with financial economic theory and empirical research, the language used by the *Cammer* court describes the factors not as a checklist of five necessary factors, but rather as individual pieces of evidence that are each probative of the degree to which the market for a security is expected to be efficient:

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“The Role and Regulation of the Research Analyst,” by Jill Fisch, Chapter 17 of the *Research Handbook on the Economics of Corporate Law*, edited by Claire Hill and Brett McDonnell, Edward Elgar, 2012, pp. 315 and 317 (“The role of the research analyst (also known as an equity analyst or a securities analyst) is to provide information to the marketplace. Analysts enhance capital market efficiency by enabling stock prices to reflect information and by reducing the need for each investor individually to gather and analyze that information. ... Research analysts collect information about specific firms and the overall market. They then package that information for use by investors in trading decisions.”);

“Investment Analysis and the Adjustment of Stock Prices to Common Information,” by Michael Brennan et al., *The Review of Financial Studies*, vol. 6, no. 4, 1993, p. 800 (“Recent theory suggests that the number of analysts may have an effect on the speed of adjustment to new information. For instance, Holden and Subrahmanyam (1992) and Foster and Viswanathan (1993), in important extensions to the classic model of Kyle (1985), have shown that as the number of informed investors increases, the share price will reflect new information more rapidly; this would suggest an association between the number of analysts and the speed of adjustment, if the number of analysts can be regarded as a proxy for the number of informed investors.”).

“There are several different characteristics pertaining to the markets for individual stocks which are probative of the degree to which the purchase price of a stock should reflect material company disclosures.”  
*Cammer*, 711 F. Supp. at 1283.

48. The *Cammer* opinion describes the nature of the five factors as follows:

“There are several types of facts which, if alleged, might give rise to an inference that Coated Sales [stock] traded in an efficient market. It is useful to set forth an explanation of how the existence of such facts would cause the understanding that disclosed company information (or misinformation) would be reflected in the company’s stock price, the underpinning of the fraud on the market theory. *Peil, supra*, 806 F.2d at 1160.”  
*Id.* at 1285-86 (footnote omitted).

“First, plaintiffs could have alleged there existed an average weekly trading volume during the class period in excess of a certain number of shares. *Abell v. Potomac Ins. Co.*, 858 F.2d 1104, 1121 (5th Cir. 1988).”  
*Id.* at 1286 (footnote omitted).

“Second, it would be persuasive to allege a significant number of securities analysts followed and reported on a company’s stock during the class period.”  
*Id.*

“Third, it could be alleged the stock had numerous market makers.”  
*Id.*

“Fourth, as discussed, it would be helpful to allege the company was entitled to file an S-3 Registration Statement in connection with public offerings ....”  
*Id.* at 1287.

“Finally, it would be helpful to a plaintiff seeking to allege an efficient market to allege empirical facts showing a cause and effect relationship between unexpected corporate events or financial releases and an immediate response in the stock price.”  
*Id.*

“As previously noted, one of the most convincing ways to demonstrate efficiency would be to illustrate, over time, a cause and effect relationship between company disclosures and resulting movements in stock price.”  
*Id.* at 1291.

## 2. The *Krogman* Factors

49. In addition to the five *Cammer* factors that indicate market efficiency discussed above, numerous courts consider three additional factors recognized by the Fifth Circuit Court of Appeals in *Unger v. Amedisys, Inc.*, 401 F.3d 316 (5th Cir. 2005), and the district court in *Krogman*, to be indicative of market efficiency. These additional factors, the *Krogman* factors, are 1) the company’s market capitalization, 2) the stock’s float, and 3) the typical bid-ask spread.
50. Market capitalization is the total value of all outstanding shares. It equals the number of shares outstanding multiplied by the market price per share. Typically, the larger a company’s market capitalization, the more prominent and well-known the company is. Larger companies tend to attract more analyst and news media coverage and gain the attention of greater numbers of investors, including large institutional investors. All of these characteristics, which accompany a large market capitalization, promote market efficiency.
51. A stock’s float is the number of shares outstanding less shares held by insiders and affiliated corporate entities. It is the number of shares available for trading by outside investors in the open market. Float is closely related to market capitalization but focuses on the shares available for trading rather than all outstanding shares. Stocks with large floats tend to trade more actively, attract more analyst and news media coverage, and garner the attention of a greater number of investors, including large institutional investors. All of these characteristics, which occur when a company has high float, promote market efficiency.
52. The bid-ask spread is the difference between the price at which market makers are offering to buy a security and the price at which they are offering the security for sale. If a security is actively traded and information about the security is readily available, the bid-ask spread

tends to be narrow. A narrow bid-ask spread makes trading in the security less costly for investors and thereby tends to attract greater interest, greater coverage, and greater volume, all of which, in turn, promote market efficiency.<sup>22</sup>

53. Villanueva and Feinstein [2021] empirically examined and tested the market capitalization and bid-ask spread *Krogman* factors and found them to be generally dispositive indicators of stock price reactivity and therefore informational market efficiency.<sup>23</sup>

### 3. Courts in the First Circuit Apply the *Cammer* and *Krogman* Factors

54. Courts in the First Circuit have accepted and applied the *Cammer* and *Krogman* factors as dispositive of market efficiency.

“To argue that AVEO shares traded in an efficient market during the Class Period, Plaintiffs submitted sufficient evidence supporting each of the factors enumerated in Cammer v. Bloom, 711 F. Supp. 1264 (D.N.J. 1989). D. 146, at 18-22. The Cammer factors include (1) the stock's average trading volume; (2) the number of securities analysts that followed and reported on the stock; (3) the presence of market makers and arbitrageurs; (4) the company's eligibility to file a Form S-3 Registration Statement; and (5) ‘a cause-and-effect relationship between unexpected corporate events or financial releases and an immediate response in stock price.’ Cammer, 711 F. Supp. at 1286-87.”

*In re Aveo Pharms., Inc. Sec. Litig.*, Civil Action No. 13-11157 (D. Mass. Nov. 14, 2017), fn 1.

“They also have demonstrated through the report of their expert Chad Coffman ‘that the markets for GTAT stock, 3% Notes, and options were efficient during the Class Period,’ as analyzed under the Cammer and Krogman factors. See Pls. Mot. for Class Cert. Mem. (doc. no. 203-1) (citing Coffman Report, Sections VII, VIII, IX (doc. no. 203-3) at 11-59); see generally Cammer v. Bloom, 711 F. Supp. 1264 (D. N.J. 1989) (identifying as relevant factors (1) average weekly trading volume, (2) analyst coverage, (3) market makers, (4) SEC Form S-3 eligibility, and (5) price reaction to unexpected information, in addition to other factors courts

<sup>22</sup> See, e.g., “The Cost of Transacting,” by Harold Demsetz, *The Quarterly Journal of Economics*, vol. 82, no. 1, 1968, pp. 33-53; “Bid-Ask Spreads and Trading Activity in the S&P 100 Index Options Market,” by Thomas George and Francis Longstaff, *Journal of Financial and Quantitative Analysis*, vol. 28, no. 3, 1993, pp. 381-397; and “Liquidity and Market Efficiency,” by Tarun Chordia et al., *Journal of Financial Economics*, vol. 87, 2008, pp. 249-268.

<sup>23</sup> “Stock Price Reactivity to Earnings Announcements: The Role of the *Cammer/Krogman* Factors,” by Miguel Villanueva and Steven Feinstein, *Review of Quantitative Finance and Accounting*, vol. 57, no. 1, 2021, pp. 203-234.

consider in addressing efficiency); *Krogman v. Sterritt*, 202 F.R.D. 467, 474 (N.D. Tex. 2001) (identifying as additional factors ‘(1) the capitalization of the company; (2) the bid ask spread of the stock; and (3) the percentage of stock not held by insiders (the ‘float’)’”  
*Levy v. Gutierrez*, 448 F. Supp. 3d 46 (D.N.H. 2019), fn 13.

## VII. ANALYSIS OF EFFICIENCY OF THE MARKET FOR PEGA STOCK

55. To assess whether the market for Pega stock was efficient during the Class Period, I analyzed the market for, and behavior of, Pega stock, focusing on the *Cammer* and *Krogman* factors over the course of the Class Period.

### A. Trading Volume (*Cammer* Factor 1)

56. Throughout the Class Period, Pega stock traded regularly and actively. On average, 325,021 shares changed hands daily.<sup>24</sup> The total number of shares traded during the Class Period was 155.68 million. Pega stock trading volume data are presented in Exhibit-4.

57. In addition to average daily and total trading volume, another informative volume metric to consider in assessing market efficiency is the percentage of outstanding shares that turn over each week. In the case of the common stock of Coated Sales, Inc. – the security at issue in the *Cammer* case - the *Cammer* court cited the conclusion of Alan Bromberg and Lewis Lowenfels that “average weekly trading of 2% or more of the outstanding shares would justify a strong presumption that the market for the security is an efficient one.”<sup>25</sup> During the Class Period, the average weekly trading volume of Pega stock was 1.63 million shares, or 2.00% of shares outstanding.<sup>26,27</sup> Thus, the trading volume for Pega stock during the Class Period was at the threshold for a strong presumption of market efficiency.<sup>28</sup>

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<sup>24</sup> Data obtained from CRSP.

<sup>25</sup> *Cammer*, 711 F. Supp. at 1293.

<sup>26</sup> The percentage is computed by averaging the daily ratio of the trading volume to the number of shares outstanding and multiplying by five, the number of trading days in a typical week.

<sup>27</sup> During the Examination Period, the average weekly trading volume of Pega stock was 1.85 million shares, or 2.27% of shares outstanding. The average weekly turnover of Pega stock as a percentage of outstanding float was 4.54% during the Examination Period.

<sup>28</sup> *Cammer*, 711 F. Supp. at 1286.

58. The average weekly turnover of Pega stock as a percentage of outstanding float was 4.01%.<sup>29</sup> This turnover exceeds the 2% threshold for a strong presumption of market efficiency.
59. In terms of total Class Period volume, average daily trading volume, and the percentage of outstanding shares traded weekly, the market for Pega stock was active. Consistent with the *Cammer* opinion, economic theory, and published empirical research, the active trading volume in Pega stock is strong evidence that the market for Pega stock was an efficient market during the Class Period.

**B. Analyst Coverage and Other Avenues of Information Dissemination  
(*Cammer* Factor 2)**

**1. Analyst Coverage**

60. Securities analysts interpret and disseminate information about the companies they cover. They conduct research and provide valuation opinions, which helps market participants acquire relevant information and understand the implications of that information for valuation and investment decisions. Consequently, securities analysts facilitate the flow of information and the digestion of information within the marketplace. The presence of analysts, and their function within the marketplace, promote efficiency.
61. Barber et al. [1994] found that coverage by one or two analysts strengthened the presumption of efficiency for a publicly traded stock.<sup>30</sup>
62. Over the course of the Class Period, nine different analysts contributed to the consensus estimates of Pega's revenue reported by *Refinitiv Eikon*, indicating that at least nine analysts covered Pega.<sup>31</sup>
63. I obtained analyst reports about Pega published during the Class Period by 18 different analyst firms: Barclays, CFRA Equity Research, Crispidea, D. A. Davidson & Company, Goldman Sachs, JMP Securities, JPMorgan, KeyBanc Capital Markets, Loop Capital

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<sup>29</sup> The percentage is computed by averaging the daily ratio of the trading volume to the number of shares in float and multiplying by five, the number of trading days in a typical week.

<sup>30</sup> "The Fraud-on-the-Market Theory and the Indicators of Common Stocks' Efficiency," by Brad Barber et al., *The Journal of Corporation Law*, 1994, pp. 310-311.

<sup>31</sup> *Refinitiv Eikon*.

Markets, Macquarie Research, Morningstar, Needham & Company, RBC Capital Markets, Rosenblatt Securities, SMBC Nikko Securities, The Benchmark Company, Truist Securities, and Wedbush Securities.<sup>32</sup>

64. Coverage by 18 analyst firms is broad analyst coverage. Pega's analyst coverage was far more extensive than the coverage by one or two analysts that Barber et al. [1994] found strengthened the presumption of efficiency for a publicly traded stock.
65. Consistent with the *Cammer* opinion, financial economic principles, and published empirical research, the extensive coverage of Pega by professional securities analysts is compelling evidence that the market for Pega stock was an efficient market throughout the Class Period.

## 2. Institutional Ownership and Buy-Side Analysis

66. Consistent with published empirical research,<sup>33</sup> some courts have also considered high institutional ownership of a security to be indicative of market efficiency.<sup>34</sup> Large institutional investors bring their expertise and sophistication to the marketplace. Large investment firms often employ financial analysts who conduct their own research on the securities they buy, thereby expanding analyst coverage.
67. *Refinitiv Eikon* compiles and provides institutional ownership data derived from SEC Form 13-F filings. Those filings and data show the holdings of Pega stock by major investment institutions as of the end of each calendar quarter. Major institutions are defined as firms or individuals that exercise investment discretion over the assets of others in excess of \$100 million.

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<sup>32</sup> The same 18 analyst firms published reports about Pega during the Examination Period.

<sup>33</sup> See, e.g., "The Fraud-on-the-Market Theory and the Indicators of Common Stocks' Efficiency," by Brad Barber et al., *The Journal of Corporation Law*, 1994; and "Sophisticated Investors and Market Efficiency: Evidence from a Natural Experiment," by Yong Chen et al., *Journal of Financial Economics*, vol. 138, no. 2, 2020.

<sup>34</sup> See, e.g., *In re Alstom SA Securities Litigation*, 253 F.R.D. 266, 280 (S.D.N.Y. 2008); and *Smilovits v. First Solar, Inc.*, 295 F.R.D. 423, 437 (D. Ariz. 2013).

68. According to SEC filings compiled and reported by *Refinitiv Eikon*, at least 586 major institutions owned Pega stock during the Class Period.<sup>35,36</sup> This widespread institutional ownership further supports a conclusion that the market for Pega stock traded in an efficient market during the Class Period.

### 3. News Coverage

69. Although the *Cammer* court focused its assessment of the second *Cammer* factor on coverage by securities analysts, other courts have noted that news media – including availability of news reports on the internet and other electronic sources – also facilitate the flow of information to the marketplace, thereby promoting market efficiency.<sup>37</sup> In the case of Pega, news media coverage was extensive.
70. My search of the Factiva database found 916 articles published about the Company during the Class Period.<sup>38,39</sup> The articles I obtained from Factiva include published news articles and press releases.
71. Information about Pega was also disseminated in the form of SEC filings and during conference calls.
72. Therefore, throughout the Class Period, information about Pega was readily available to market participants through the news media, analyst reports, Company financial reports, Company statements, and various other sources. This extensive news coverage and

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<sup>35</sup> According to the data compiled and reported by *Refinitiv Eikon*, 586 institutions held shares of Pega stock on at least one of the following quarterly reporting dates during the Class Period: 30 June 2020, 30 September 2020, 31 December 2020, 31 March 2021, 30 June 2021, 30 September 2021, 31 December 2021, and 31 March 2022. There may have been additional institutions that held Pega stock during the Class Period, though not on those quarterly reporting dates.

<sup>36</sup> According to the data compiled and reported by *Refinitiv Eikon*, 601 institutions held shares of Pega stock on at least one of the following quarterly reporting dates during the Examination Period: 30 June 2020, 30 September 2020, 31 December 2020, 31 March 2021, 30 June 2021, 30 September 2021, 31 December 2021, 31 March 2022 and 30 June 2022. There may have been additional institutions that held Pega stock during the Examination Period, though not on those quarterly reporting dates.

<sup>37</sup> See, e.g., *Cheney v. Cyberguard Corp.*, 213 F.R.D. 484, 499 (S.D. Fla. 2003); and *In Re Banc of California Securities Litigation*, 326 F.R.D. 640, 649 (C.D. Cal. 2018).

<sup>38</sup> This figure is based on a Factiva search in “All Sources” for articles published during the Class Period where “Pegasystems Inc.” was the “Company” search field parameter.

<sup>39</sup> My search of the Factiva database found 1,364 articles published about the Company during the Examination Period.



provision of information is further evidence of the efficiency of the market for Pega stock throughout the Class Period.

**C. Listing on the Nasdaq, Number of Market Makers, and Presence of Arbitrageurs (*Cammer* Factor 3)**

73. The market-making infrastructure for a stock, including the number of market makers in particular, is the third factor that the *Cammer* court determined indicates market efficiency. Market makers are financial intermediaries who trade in a particular security, standing ready to buy and sell with individual investors, institutions, and other market makers. A large number of market makers implies that many market participants are trading that particular stock. A large number of market makers for a particular stock provides a high degree of liquidity and lowers transaction costs. With a large number of market makers, it is generally easy for investors to execute trades in a timely fashion and with reasonable transaction costs. These features preclude certain potential impediments to trading and conveyance of information, and therefore promote market efficiency.
74. The *Cammer* court's understanding that the market-making infrastructure of a stock market is indicative of its efficiency makes the fact that Pega stock traded on the Nasdaq during the Class Period highly relevant. The Nasdaq is an electronic exchange consisting of multiple competing market makers using electronic systems to make quotes and effect trades. The subject company in the *Cammer* case, Coated Sales, Inc., was listed on the Nasdaq. In fact, citing Bromberg & Lowenfels, the *Cammer* court noted specifically the importance of a Nasdaq listing and the implications of such a listing for market efficiency. The *Cammer* court stated stating that market efficiency can reasonably be presumed for virtually all securities traded on the Nasdaq:

“We think that, at a minimum, there should be a presumption – probably conditional for class determination – that certain markets are developed and efficient for virtually all the securities traded there: the New York and American Stock Exchanges, the Chicago Board Options Exchange and the NASDAQ National Market System.”

*Cammer*, 711 F. Supp. at 1292 (quoting Bromberg & Lowenfels, 4 *Securities Fraud* [1988], at §8.6).

75. Bloomberg identifies the Pega stock market makers over the course of the Class Period. According to Bloomberg, there were 89 market makers active in Pega stock between July 2020 through April 2022. These market makers included such well-known firms as Barclays, Credit Suisse, Goldman Sachs, Morgan Stanley, and UBS.
76. Pega stock satisfied the market infrastructure *Cammer* factor two ways. First, Pega stock was listed on the Nasdaq. Second, there were 89 identified Nasdaq market makers that also facilitated trading in Pega stock during the Class Period.<sup>40</sup>
77. The *Cammer* court also cited the presence of arbitrageurs along with market makers as an indicator of market efficiency.<sup>41</sup> Arbitrageurs are traders who attempt to profit from any immediate mispricing of a security. Their trading quickly drives out mispricings.<sup>42</sup>
78. There are no publicly available data on the identities or specific activities of arbitrageurs in particular securities, but reasonable proxies do exist. Arbitrage opportunities tend to be short-lived, and because quickness matters and profit margins are small, arbitrage activity tends to be undertaken by large, well-capitalized, sophisticated institutions.<sup>43</sup> Consequently, the number of major institutions who held Pega stock and the number of institutions whose holdings changed during the Class Period provide a gauge of arbitrage activity in the market for Pega stock. Similarly, an active market for short-selling also indicates likely arbitrage activity.
79. Both these elements reveal the likely presence of arbitrageurs in the market for Pega stock. According to the institutional holdings data obtained from *Refinitiv Eikon*, of the 586 institutions that held shares of Pega stock on at least one of the quarterly reporting dates during the Class Period, 323 of those institutions, or 55.12%, reported a change in the number of shares held during the Class Period.<sup>44</sup> Quarterly institutional holding figures are shown in Exhibit-5a and Exhibit-5b. These data show that as a group, major institutions

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<sup>40</sup> There were 98 identified Nasdaq market makers that facilitated trading in Pega stock during the Examination Period.

<sup>41</sup> *Cammer*, 711 F. Supp. at 1286-1287.

<sup>42</sup> See, e.g., *Investments*, by Zvi Bodie et al., 12<sup>th</sup> ed., McGraw-Hill Education, 2021, p. 311.

<sup>43</sup> See, e.g., *Corporate Finance: Core Principles & Applications*, by Stephen Ross et al., 2<sup>nd</sup> ed., McGraw-Hill/Irwin, 2009, p. 399.

<sup>44</sup> According to the institutional holdings data obtained from *Refinitiv Eikon*, of the 601 institutions that held shares of Pega stock on at least one of the quarterly reporting dates during the Examination Period, 329 of those institutions, or 54.74%, reported a change in the number of shares held during the Examination Period.

were not inactive investors, but rather adjusted their positions – a marker of potential arbitrage activity.

80. Furthermore, as shown in Exhibit-6, which presents Pega stock short interest data provided by Bloomberg, there was considerable Pega stock short-selling activity over the course of the Class Period.
81. That Pega stock traded on the Nasdaq, with numerous market makers and the likely participation of arbitrageurs, compels the conclusion that the well-developed market for Pega stock was an efficient market throughout the Class Period.

**D. Form S-3 Registration Eligibility (*Cammer* Factor 4)**

82. Form S-3 registration is a simplified form which publicly traded U.S. companies can use to register securities with the SEC for a security offering in order to raise capital. Also known as “short-form” registration, Form S-3 registration is simpler and more expedited compared to a regular Form S-1 registration. However, to be eligible for Form S-3 registration, companies must satisfy certain requirements pertaining to size and report filing history. The *Cammer* court explained that the criteria for S-3 registration eligibility are such that S-3 registration eligibility indicates market efficiency.<sup>45</sup>
83. At the time of the *Cammer* opinion, the conditions for Form S-3 registration were that a company had filed financial reports with the SEC for 36 months and had an outstanding float over \$150 million held by non-affiliates, or \$100 million of such float coupled with annual trading volume exceeding 3 million shares.<sup>46</sup>
84. In 1992, the SEC revised its Form S-3 registration eligibility requirements to 12 months of filings and at least \$75 million of float. Since 2008, the SEC has allowed companies with less than \$75 million of float to file a Form S-3 registration as long as the company has been filing financial reports for at least a year, has “a class of common equity securities listed and registered on a national securities exchange, and the issuers do not sell more than

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<sup>45</sup> *Cammer*, 711 F. Supp. at 1284-1285.

<sup>46</sup> “Revisions to the Eligibility Requirements for Primary Securities Offerings on Forms S-3 and F-3,” SEC Release No. 33-8812, 20 June 2007.

the equivalent of one-third of their public float in primary offerings over any period of 12 calendar months.”<sup>47</sup>

85. The *Cammer* court observed that Form S-3 registration eligibility is indicative of market efficiency because the filing requirement ensures that financial data are available to market participants, and the “public float” requirement indicates that many market participants would have examined the information. The *Cammer* court explained, as follows:

“Proposed Form S-3 recognizes the applicability of the efficient market theory to the registration statement framework with respect to those registrants which usually provide high quality corporate reports, including Exchange Act reports, and whose corporate information is broadly disseminated, because such companies are widely followed by professional analysts and investors in the market place. ... Because of the foregoing observations made by the SEC, the existence of Form S-3 status is an important factor weighing in favor of a finding that a market is efficient.” *Cammer*, 711 F. Supp. at 1284-85.

“The ‘public float’ aspect of the Form S-3 requirements ensures that enough investors have in fact read the previously filed document.” *Id.* at 1285.

86. Pega regularly and timely filed required SEC financial reports. Also, Pega’s average float during the Class Period of \$4.73 billion far exceeded the \$75 million float size required for S-3 registration. Pega’s float exceeded the float requirement throughout the Class Period. With annual trading volume greater than 3 million, Pega even satisfied the original stricter float requirement for the filing of a Form S-3. Satisfying all requisite conditions, Pega was eligible for S-3 registration throughout the Class Period.<sup>48</sup>
87. Consistent with the *Cammer* opinion, Pega’s eligibility for Form S-3 registration is compelling evidence of the efficiency of the market for Pega stock throughout the Class Period.

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<sup>47</sup> “Revisions to the Eligibility Requirements for Primary Securities Offerings on Forms S-3 and F-3,” SEC Release No. 33-8878, 19 December 2007.

<sup>48</sup> Pega regularly and timely filed required SEC financial reports throughout the Examination Period. Also, Pega’s average float during the Examination Period of \$4.28 billion far exceeded the \$75 million float size required for S-3 registration. Pega’s float exceeded the float requirement throughout the Examination Period. Satisfying all requisite conditions, Pega was eligible for S-3 registration throughout the Examination Period.

**E. *Krogman* Factors**

88. In addition to evaluating market efficiency based on the *Cammer* factors, I also examined Pega stock and its market with respect to the three *Krogman* factors.

**1. Market Capitalization (*Krogman* Factor 1)**

89. During the Class Period, Pega ranked among the largest companies listed for trading in the U.S., as measured by market capitalization. Pega was not a small, obscure company, which escaped the notice of market participants. Rather, Pega was a large, highly visible, and well-covered company.
90. Over the course of the Class Period, the market capitalization of Pega stock ranged between \$5.39 billion and \$11.87 billion, averaging \$9.49 billion. This average market capitalization was larger than the respective market capitalizations of 89.90% of all publicly traded companies in the U.S.<sup>49,50</sup> Even at its lowest point during the Class Period, Pega's market capitalization was still larger than 85.30% of all other publicly traded companies in the U.S.
91. Consistent with the *Krogman* opinion and the financial economic principles discussed above, the sizeable market capitalization of Pega stock supports a conclusion that the market for Pega stock was efficient throughout the Class Period.

**2. Float (*Krogman* Factor 2)**

92. Float is closely related to market capitalization but excludes insider and closely held shares. Float is therefore a measure of shares available for trading by the general public. Float can be analyzed in terms of number of shares, dollar value, and also as a percentage of total shares outstanding.

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<sup>49</sup> Average market capitalizations during the Class Period for all other companies were computed as averaged month-end values, using data from CRSP for June 2020 through April 2022.

<sup>50</sup> Over the course of the Examination Period, the market capitalization of Pega stock averaged \$8.59 billion, which was larger than the respective market capitalizations of 89.50% of all publicly traded companies in the U.S. Average market capitalizations during the Examination Period for all other companies were computed as averaged month-end values, using data from CRSP for June 2020 through August 2022.

93. On average during the Class Period, there were 81.12 million shares outstanding, of which 40.46 million (49.88%) were in float. Over the course of the Class Period, the market value of Pega's stock float ranged between \$2.72 billion and \$5.92 billion, averaging \$4.73 billion. This average float was larger than the entire respective market capitalizations (including shares held by insiders and affiliates) of 84.00% of all other publicly traded companies in the U.S.<sup>51</sup>
94. While insiders did hold a substantial portion of issued Pega stock, the quantity of Pega stock not held by insiders was very large, and larger than the total market capitalizations of most other publicly traded companies in the U.S. As such, Pega's float satisfied the second *Krogman* factor for market efficiency.

### 3. Bid-Ask Spread (*Krogman* Factor 3)

95. I obtained from CRSP the daily closing bid and ask quotes for Pega stock during the Class Period. I measured the percentage bid-ask spread as the difference between the bid and ask quotes divided by the average of the bid and ask quotes, which is the standard way of measuring percentage bid-ask spreads in the finance literature.<sup>52</sup> Exhibit-4 presents bid and ask price data for Pega stock.
96. The average bid-ask spread for Pega stock over the course of the Class Period was 0.13%. By comparison, the average month-end bid-ask spread over the course of the Class Period for all stocks in the CRSP database, which comprises all stocks traded on U.S. exchanges, was 0.48%.<sup>53,54</sup> The Pega stock percent bid-ask spread was therefore substantially narrower than the average.

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<sup>51</sup> On average during the Examination Period, there were 81.24 million shares outstanding, of which 40.60 million (49.97%) were in float. Over the course of the Examination Period, the market value of Pega's stock float averaged \$4.28 billion, which was larger than the entire respective market capitalizations (including shares held by insiders and affiliates) of 83.30% of all other publicly traded companies in the U.S.

<sup>52</sup> "Price Reversals, Bid-Ask Spreads, and Market Efficiency," by Allen Atkins and Edward Dyl, *Journal of Financial and Quantitative Analysis*, vol. 25, no. 4, 1990, pp. 535-547.

<sup>53</sup> This calculation is based upon averaged month-end data from CRSP for June 2020 through April 2022.

<sup>54</sup> The average bid-ask spread for Pega stock over the course of the Examination Period was 0.13%. By comparison, the average month-end bid-ask spread over the course of the Examination Period for all stocks in the CRSP database, which comprises all stocks traded on U.S. exchanges, was 0.51%. This calculation is based upon averaged month-end data from CRSP for June 2020 through August 2022.

97. In dollar terms, the Pega stock bid-ask spread during the Class Period averaged \$0.16 per share. For all stocks in the CRSP database, the average bid-ask spread was \$0.19 per share during the Class Period.<sup>55</sup> Pega stock's dollar bid-ask spread was narrower than the average level among all stocks traded on U.S. exchanges.
98. The average bid-ask spread in the market for Pega stock over the course of the Class Period was below the typical bid-ask spreads exhibited by other publicly traded stocks in the U.S., as measured in either percent or dollar terms. This narrow bid-ask spread in the market for Pega stock supports a conclusion of market efficiency.

#### **VIII. EMPIRICAL DEMONSTRATION OF MARKET EFFICIENCY (*Cammer* Factor 5)**

99. The fifth *Cammer* factor is empirical evidence showing a cause-and-effect relationship between the release of company-specific information and movements in the stock price.<sup>56</sup> The *Cammer* court noted that a demonstration of a cause-and-effect relationship “would be helpful to a plaintiff seeking to allege an efficient market.”<sup>57</sup>
100. While the *Cammer* court stated that the empirical factor is “helpful” and “convincing,” my understanding is that more recently, consistent with financial principles and published empirical findings, courts have found that the empirical *Cammer* factor is not necessary to establish market efficiency, especially when the other factors are satisfied and circumstances are not unusual.<sup>58</sup>
101. Nonetheless, significant stock price reactions to new, valuation-relevant information do demonstrate market efficiency and are compelling evidence of market efficiency. The empirical event study analysis that I conducted on Pega stock provides such evidence.

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<sup>55</sup> In dollar terms, the Pega stock bid-ask spread during the Examination Period averaged \$0.14 per share. For all stocks in the CRSP database, the average bid-ask spread was \$0.19 per share during the Examination Period. This calculation is based upon averaged month-end data from CRSP for June 2020 through August 2022.

<sup>56</sup> *Cammer*, 711 F. Supp. at 1291.

<sup>57</sup> *Cammer*, 711 F. Supp. at 1287.

<sup>58</sup> See, e.g., *Waggoner v. Barclays PLC*, 875 F.3d 79, 97 (2d Cir. 2017) (“a plaintiff seeking to demonstrate market efficiency need not always present direct evidence of price impact through event studies”).

102. Pega stock reacted to Company announcements. The stock price movements following earnings announcements were statistically significant more frequently than were the stock price movements on all other days, which were predominantly ordinary days with less information flow. These results prove that the Pega stock price responded to Company-specific information released during the Class Period, which is the hallmark of an efficient market. There was indeed a cause-and-effect relationship between the release of new Company information and changes in Pega's stock price, which demonstrates market efficiency.

#### **A. Event Studies**

103. Event studies test whether a security responds to new information. Event study analysis is one of the most commonly used analytic methodologies employed by finance researchers to assess the impact of information and events on security prices.
104. Campbell et al. [1997] described and provided examples of the event study methodology and wrote about how this method is generally accepted and widely used in academic research.<sup>59</sup> Gold et al. [2017] described how the methodology is generally accepted and widely used in forensic applications.<sup>60</sup>
105. An event study measures how much a security price rises or falls in response to new, company-specific information. One component of an event study is the statistical regression analysis that determines how much of a security price change is explained by market-wide and industry sector factors, rather than company-specific information, so that those influences can be statistically factored out. The portion of a security price change that cannot be attributed to market-wide or sector factors is called the residual security price movement or "residual return." The event study isolates the residual return and also tests whether or not the residual return can reasonably be explained as merely a random fluctuation.

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<sup>59</sup> "Event-Study Analysis," by John Campbell et al., Chapter 4 of *The Econometrics of Financial Markets*, Princeton University Press, 1997.

<sup>60</sup> "Federal Securities Acts and Areas of Expert Analysis," by Kevin Gold et al., Chapter 27 of the *Litigation Services Handbook: The Role of the Financial Expert*, 6<sup>th</sup> ed., edited by Roman Weil et al., John Wiley & Sons, Inc., 2017.



106. If a stock's event date residual return is statistically significant, it indicates that the stock price movement cannot be attributed to market factors, sector factors, or random volatility, but rather was caused by new, company-specific information. A significant stock price reaction to the release of information demonstrates market efficiency. It is proof that the stock price responded to information.

## **B. Collective Event Study Test**

### **1. Collective Event Study Test Design and Methodology**

107. If a company's news events collectively exhibit a significantly greater frequency of statistically significant stock price movements than do non- or lesser-news days, this finding establishes that the stock consistently reacts to company-specific information and it is therefore compelling empirical evidence that the stock trades in an efficient market. One can test for market efficiency, therefore, by assessing collectively whether the stock exhibits statistically significant returns more often on days with greater information flow than on more typical days with less news. If the frequency of statistically significant stock price movements is greater among a collection of news days than among all other non- or lesser-news days, this result would establish that there is a cause-and-effect relationship between the flow of company information and stock price movements, which indicates market efficiency.
108. The group of eight testifying finance experts (including myself) who wrote an *amici curiae* brief for the U.S. Supreme Court in *Halliburton II* recognized collective tests as valid tests of market efficiency. The brief explained that an empirical analysis of market efficiency may be performed as follows:

“[D]ivide the days of the class period *ex ante* into expected news days and non-news days before examining price movements, and then compare the stock's price movements in the two categories to see if there is a statistically significant difference in price movement between the two categories. If the study finds a difference in price movement between the two sample sets (e.g., earnings-release dates versus non-earnings-release dates), that is statistical evidence that the market incorporates new public information into the price of the stock.”

**“Brief of Testifying Economists as *Amici Curiae* in Support of Respondent,” *Halliburton Co. and David Lesar v. Erica P. John Fund, Inc.*, Case No. 13-317 (U.S.), 5 February 2014, p. 10.**

109. I conducted a collective event study analysis for Pega stock. I focused on the Company's earnings announcements and compared those information event dates to all other days. According to the finance literature discussed herein, the flow of company-specific information is typically elevated on earnings announcement event dates.<sup>61</sup> A greater incidence of significant stock returns on earnings announcement event dates, therefore, would show that Pega stock reacted to information, which is the essence of informational market efficiency.<sup>62</sup>

## 2. Collective Event Study Tests of Market Efficiency Are Widely Used and Accepted by Courts

110. Collective event study tests that compare price movements on news days to non- or lesser-news days for purposes of assessing market efficiency are widely used in securities cases, are presented in the literature, and have been accepted by courts.<sup>63</sup> Numerous courts have accepted collective event study tests as valid tests for establishing market efficiency and have acknowledged their "routine use" for this purpose.<sup>64</sup>

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<sup>61</sup> *Financial Reporting: An Accounting Revolution*, by William Beaver, 3<sup>rd</sup> ed., Prentice-Hall, 1998, p. 38; and "Earnings Management to Exceed Thresholds," by François Degeorge et al., *The Journal of Business*, vol. 72, no. 1, 1999, p. 1.

<sup>62</sup> The collective event study test I conducted compares days on which the Company made earnings announcements (which often convey a great deal of company information) to all other days (which comprise predominantly non- or lesser-news days). However, the group of non- or lesser-news days may contain some important information events. The groupings for comparison purposes do not imply that there was a determination that there was little or no important news on every one of the days designated as non- or lesser-news days. Some important news days may have been included in the non- or lesser-news day group only because they were not earnings announcement events, which was the criterion for designation as a news day in the design of the collective event study herein. As long as earnings announcements typically convey important information, and most of the other days convey less information, the comparison of the two groups can determine whether or not the security responds to information.

<sup>63</sup> "The Curious Incident of the Dog That Didn't Bark and Establishing Cause-and-Effect in Class Action Securities Litigation," by Michael Hartzmark and H. Nejat Seyhun, *Virginia Law & Business Review*, vol. 6, no. 3, 2012, pp. 458-459 (footnote omitted).

<sup>64</sup> *City of Cape Coral Municipal Firefighters' Retirement Plan v. Emergent Biosolutions, Inc.*, HQ, 322 F. Supp. 3d 676, 688 (D. Md. 2018) ("Additionally, experts routinely use, and courts accept, collective tests on the earnings and guidance dates like the one utilized by Bettencourt. See *In re NII Holdings*, 311 F.R.D. [401, 412 (E.D. Va. 2015)] (finding expert's collective test of company's earnings announcements objective and reliable).") See also *McIntire v. China MediaExpress Holdings, Inc.*, 38 F. Supp. 3d 415, 430 (S.D.N.Y. 2014), *In re Petrobras Securities Litigation*, 312 F.R.D. 354, 369 (S.D.N.Y. 2016); and *Lehocky v. Tidel Technologies, Inc.*, 220 F.R.D. 491, 506 (S.D. Tex. 2004).

111. The following are excerpts about collective tests from the professional forensic and academic finance literature:

“We start by examining the statistical properties of the cause-and-effect relationship between stock returns and disclosures when there is no link. In other words, the daily stock prices do not reflect full information and that significant abnormal returns are not associated with the disclosure of information. It then logically follows that, for this security we will observe that: (a) the security’s returns are determined arbitrarily or in a random fashion, and (b) there will be no link between disclosures and significant abnormal returns, in other words, disclosures and significant returns are randomly distributed. To test this hypothesis, we have established a novel statistical method employing a generally accepted approach called ‘bootstrap testing.’ Both the *DVI* and *HealthSouth* courts have accepted the bootstrap approach. We have created test statistics to determine if the actual observations are likely to have been generated in a random fashion. If information disclosures are not linked to abnormal returns, then we would not expect there to be a statistically significant relationship that distinguishes those days when there are or are not disclosures of information from those days when there are or are not abnormal returns. In other words, there is no cause-and-effect correlation because the distributions of abnormal returns and disclosures are both random events.”

**“The Curious Incident of the Dog That Didn’t Bark and Establishing Cause-and-Effect in Class Action Securities Litigation,”** by Michael Hartzmark and H. Nejat Seyhun, *Virginia Law & Business Review*, vol. 6, no. 3, 2012, pp. 458-459 (footnote omitted).

“In terms of the application of the EMH [Efficient Market Hypothesis] to securities class actions, an important question is whether any allegedly fraudulent information would cause a change in the issuer’s stock price. However, because the market does not know (at the time) whether any information it receives is legitimate or fraudulent, this question can be answered by testing whether the market for a particular issuer’s stock responds to news more generally. If it does, then one is more confident that the stock price would be affected by any material false information or would have responded to material omitted information. If the stock price does not generally respond to news, then the presumption should then become that the stock was not affected by any false news and may not have responded to allegedly omitted information. Because stock prices move all the time, one must compare the movements in response to news stories with a control group of prices.”

**“The ‘Less Than’ Efficient Capital Markets Hypothesis: Requiring More Proof from Plaintiffs in Fraud-on-the-Market Cases,”** by Paul Ferrillo et al., *St. John’s Law Review*, vol. 78, no. 1, 2004, p. 119.

“For our application, the Fisher Exact test queries the null hypothesis that the event day incidence of significant returns is less than or equal to the non-event day incidence of significant returns. When a Fisher Exact test  $p$  value is less than or equal to 5%, one can reject the null hypothesis of non-reactivity in favor of the alternative characterization that the stock is reactive. We run the test per stock-year observation, to determine whether each particular stock in each year displayed reactivity. ... Empirical proof of reactivity demonstrates the cause and effect relationship between information and stock price movements that Courts consider as evidence of market efficiency.”

“Stock Price Reactivity to Earnings Announcements: The Role of the Cammer/Krogman Factors,” by Miguel Villanueva and Steven Feinstein, *Review of Quantitative Finance and Accounting*, vol. 57, no. 1, 2021, pp. 215 and 233.

### 3. Focus on Earnings Announcements

112. My collective event study test focused on Pega’s quarterly earnings announcements, during which the Company reported financial results and other important Company news to the public. Numerous well-known and highly regarded academic studies have specifically examined stock price movements caused by earnings announcements (for example, Beaver [1968], Ball and Brown [1968], Ball [1978], Watts [1978], Patell and Wolfson [1984], Ball and Kothari [1991], Landsman and Maydew [2002], and Villanueva and Feinstein [2021]). Such studies concur that earnings announcements are generally important information events. I examined Pega’s earnings announcements to confirm that there was generally an elevated flow of economically material information about Pega disseminated on those dates during the Class Period.
113. The Company announced earnings in press releases, which were also included in Form 8-K filings. The press releases were used to date and time the earnings announcements. Table-1 presents the dates and times of the eight Pega earnings announcements that occurred during the Class Period. Table-1 also presents the first trading date on which a stock price reaction could take place, which is the effective event date for testing purposes.<sup>65</sup>

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<sup>65</sup> There was one additional earnings announcement in the Examination Period with the effective event date 28 July 2022 (“Client Adoption Drives Pega Cloud to 70% of New Client Commitments in First Half of 2022,” *PR Newswire*, 27 July 2022, 4:05 PM.).

**Table-1: Class Period Earnings Announcements**

	Announcement Date	Release Time	Effective Event Date
[1]	Tuesday, July 28, 2020	4:05 PM	Wednesday, July 29, 2020
[2]	Wednesday, October 28, 2020	4:05 PM	Thursday, October 29, 2020
[3]	Wednesday, February 17, 2021	4:05 PM	Thursday, February 18, 2021
[4]	Wednesday, April 28, 2021	4:05 PM	Thursday, April 29, 2021
[5]	Wednesday, July 28, 2021	4:05 PM	Thursday, July 29, 2021
[6]	Wednesday, October 27, 2021	4:05 PM	Thursday, October 28, 2021
[7]	Wednesday, February 16, 2022	4:05 PM	Thursday, February 17, 2022
[8]	Thursday, April 28, 2022	4:05 PM	Friday, April 29, 2022

**Sources:**

- [1] "Pega Cloud Revenue and ACV grow by more than 50%," *PR Newswire*, 28 July 2020, 4:05 PM.
- [2] "Pega Cloud Continues to Expand in Third Quarter of 2020," *PR Newswire*, 28 October 2020, 4:05 PM.
- [3] "Cloud Growth Drives Pega Through \$1 Billion Milestone in 2020," *PR Newswire*, 17 February 2021, 4:05 PM.
- [4] "Digital Transformation Demand Increases Pega Cloud Revenue 56 percent in Q1 2021," *PR Newswire*, 28 April 2021, 4:05 PM.
- [5] "Pega continues strong first-half momentum through Q2 2021," *PR Newswire*, 28 July 2021, 4:05 PM.
- [6] "Pega continues accelerated growth through Q3 2021," *PR Newswire*, 27 October 2021, 4:05 PM.
- [7] "Annual contract value exceeds \$1 billion in Q4 2021," *PR Newswire*, 16 February 2022, 4:05 PM.
- [8] "Annual contract value grows 21 percent as profitability improves in Q1 2022," *PR Newswire*, 28 April 2022, 4:05 PM.

114. Plaintiffs contend that Company's Form 10-K filed with the SEC on 16 February 2022 contained allegation-related corrective information. But, that is not the reason this event was included in my collective event study. The event was an earnings announcement, so it satisfies the screen for inclusion as a news event and rightfully belongs within the group of news events in the collective event study for testing market efficiency.

#### 4. A Caveat About Non-Significant Security Price Movements

115. It is important to note that an event study tests the joint hypothesis that i) the stock trades in an efficient market, and ii) the appropriate valuation impact of the information disseminated on the event date is of such a large magnitude as to exceed the threshold for statistical significance, according to valuation principles. A finding of statistical

significance indicates market efficiency, but a finding of non-significance does not necessarily establish inefficiency, because a modest non-significant stock price reaction may be the appropriate and efficient stock price reaction to a particular announcement or event.<sup>66</sup>

116. For example, if a company reports business results that are in line with the expectations of analysts and investors, although the announcement would be important, the mix of information may not have changed sufficiently on that date to warrant a statistically significant stock price change. The release of important information consistent with market expectations would maintain the stock price, whereas important information inconsistent with prior expectations would cause a change in the stock price. Similarly, if an important announcement is made alongside countervailing news that impacts the stock price in the opposite direction, the mix of news may cause no statistically significant stock price reaction in an efficient market. In these examples, a modest stock price movement, or even no movement at all, may be the appropriate stock price reaction in an efficient market. In such cases, the event study finding that the stock return was non-significant would not indicate inefficiency. In fact, in such cases, the non-significant stock price movement would show that the stock behaved as it should in an efficient market.<sup>67</sup>

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<sup>66</sup> See, e.g., “Event Studies in Securities Litigation: Low Power, Confounding Effects, and Bias,” by Alon Brav and J.B. Heaton, *Washington University Law Review*, vol. 93, no. 2, 2015, p. 602.

<sup>67</sup> Of note, it is becoming increasingly recognized in the literature that the 95% confidence level is not the only statistical finding dispositive of correlation and causation. While significance at the 95% confidence level provides strong proof that the information conveyed by the disclosure event caused the price reaction, it is also well known and now generally accepted that significance at less than the 95% confidence level is informative as well.

Significance at less than the 95% confidence level certainly does not disprove that an event impacted the stock price. See, e.g., *A Guide to Econometrics*, by Peter Kennedy, 6<sup>th</sup> ed., Blackwell Publishing, 2008, p. 60 (“Hypothesis tests are usually conducted using a type I error rate (probability of rejecting a true null) of 5%, but there is no good reason why 5% should be preferred to some other percentage. The father of statistics, R.A. Fisher, suggested it in an obscure 1923 paper, and it has been blindly followed ever since. Rosnow and Rosenthal (1989, p. 1277) recognize that ‘surely, God loves the .06 as much as the .05.’”)

Note also, “New Views on Statistical Significance Affect Expert Testimony,” by Josh Becker et al., *Law360.com*, 23 May 2019 (“Statistical significance may be part of an expert’s reasoning, but the expert should also consider all possible explanations for a scientific conclusion, including study design and the underlying scientific processes that affect the result. To the extent there are other studies or data that contradict the expert’s conclusion, the expert should not dismiss that other data merely because it is not statistically significant”).

117. Similarly, when a company deceives analysts and investors by concealing important information, with either misrepresentations or omissions, the effect of the concealment would generally not be a statistically significant stock price movement at the time of the misrepresentation or omission, or over the duration of the concealment. Instead, the concealment would maintain the mix of public information as it was previously, so the price impact would be maintenance of the price level where it was previously. Thus, by keeping the stock price from falling, such a misrepresentation or omission would introduce or maintain artificial inflation by propping up the stock price.
118. A collective event study test of market efficiency does not require identification of events on which allegation-related information was disclosed. Events should be selected on the basis of an independent analysis of which candidate events are informative about market efficiency, and these events may be either related or unrelated to alleged misrepresentations, omissions, or corrective disclosures. In the same vein, an ideal candidate event for testing market efficiency should not necessarily be excluded simply because it also happens to be related to the allegations of the case.
119. When selecting events for a collective event study test of market efficiency, each event need not be so momentous as to be expected to elicit a significant stock price reaction. Rather, the group of events is selected such that the group as a whole is characterized as having higher information flow than on ordinary days. One would not expect all, or even necessarily most, of the event returns in a collective event study to be statistically significant. In a collective event study, statistical testing establishes whether the incidence rate of statistical significance within the news event group is elevated compared to all other dates. If so established, the finding proves the existence of a cause-and-effect relationship between information flow and stock price reaction, and hence demonstrated market efficiency.

#### **5. Regression Analysis to Isolate the Impact of Company-Specific Information**

120. One component of event study analysis is the determination of how much of the Company's stock return following each event was driven by market-wide and industry sector factors, as opposed to Company-specific information, so that those influences can be statistically factored out. The method, which is generally accepted and widely used in



econometric modeling, involves running a regression to determine how the price of a company's stock typically behaves in relation to market-wide and industry sector factors. The method then uses the regression model to determine how much of each event day's actual return is explained by those market and sector effects. The portion of the stock return that is attributable to market and sector factors is called the explained return.

121. The explained return is subtracted from the actual return to isolate the residual return, which is the stock's return after controlling for explanatory market and sector effects. The residual return reflects the impact of company-specific information on the stock price, if any.
122. I ran regressions modeling Pega's stock returns as a function of 1) a constant term, 2) the return of the overall stock market, and 3) a sector index return.
123. For the overall stock market factor, I used the CRSP NYSE/AMEX/NASDAQ/ARCA Market Index ("Market Index"), which is a generally accepted and widely used measure of the overall stock market performance. The Market Index appropriately incorporates payment of dividends by the constituent companies.
124. For the sector factor, I began with the same sector index that Pega identified as representative of its industry sector for SEC Regulation S-K disclosure purposes. Regulation S-K requires a public company to identify an index or peer group that is representative of its industry sector.<sup>68</sup> In annual reports, Pega compared the performance of its shares to the S&P North American Technology Sector – Software Index.<sup>69</sup>
125. The "Sector Index" I used to represent Pega's industry sector was the S&P North American Technology Sector – Software Index, reconstructed to exclude Pega.<sup>70</sup> The adjustment to exclude Pega is necessary to mitigate the simultaneity of effects, wherein Pega's returns both cause as well as are caused by changes in that index. This adjustment provides a purer measure of the independent sector effect. The Sector Index appropriately incorporates payment of dividends by the constituent companies.

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<sup>68</sup> 17 CFR § 229.201.

<sup>69</sup> Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2020, filed 17 February 2021, p. 24; Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2021, filed 16 February 2022, p. 26; and Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2022, filed 15 February 2023, p. 25.

<sup>70</sup> S&P North American Technology Sector – Software Index and constituent data obtained from S&P.



126. All returns used in the regressions are logarithmic returns – i.e., the natural logarithm of the ratio of the current day’s closing price to the previous day’s closing price. Logarithmic returns are commonly used in event studies and equity analysis because of various computational advantages. The Appendix hereto presents the mathematical formula for the logarithmic return and a discussion of the measure.
127. Event study analysis compares potentially atypical event days to typical stock return days. One purpose of the regression analysis is to establish what is the typical stock return behavior. It is therefore appropriate to control for or exclude potentially atypical days in the regression analysis. In my analysis, I used dummy variables in the regression model to control for the potentially abnormal returns on the earnings announcement event dates and the alleged corrective disclosure dates. Using dummy variables to control for potentially atypical observations in the regression estimation period, especially when those dates are the subject of the event study analysis, so that the estimated regression parameters reflect typical stock price dynamics, is a widely used and generally accepted methodology.<sup>71</sup>
128. For each date in the Class Period, I computed the explained portion of Pega’s stock return by adding 1) the estimated regression intercept term, 2) the day’s Market Index return multiplied by the Market Index regression coefficient, and 3) the day’s Sector Index return multiplied by the Sector Index regression coefficient. I then computed the residual return for each date by subtracting the explained return from the actual return.
129. Pega’s stock prices, trading volume, and returns are shown in Exhibit-4. Exhibit-7 presents the Market Index returns and Sector Index returns.
130. I ran the regression on daily returns covering the Class Period.<sup>72</sup> The choice of using data encompassing the event dates of interest for the regression estimation period is also a widely used and generally accepted practice in event study analysis. Tabak and Dunbar discuss this method, as follows:

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<sup>71</sup> See, e.g., “Event Studies with a Contaminated Estimation Period,” by Nihat Aktas et al., *Journal of Corporate Finance*, vol. 13., 2007; and “Testing for Market Efficiency: A Comparison of the Cumulative Average Residual Methodology and Intervention Analysis,” by David Larcker et al., *Journal of Financial and Quantitative Analysis*, vol. 15, no. 2, 1980.

<sup>72</sup> For the Examination Period, I ran the regression on daily returns covering the Examination Period.

“Three general choices for the placement of an estimation window are before the event window, surrounding the event window, and after the event window.”

“Materiality and Magnitude: Event Studies in the Courtroom,” by David Tabak and Frederick Dunbar, Chapter 19 of the *Litigation Services Handbook: The Role of the Financial Expert*, 3<sup>rd</sup> ed., edited by Roman Weil et al., John Wiley & Sons, Inc., 2001, p. 5.

131. The most commonly used regression estimation procedure is called “ordinary least squares.”<sup>73</sup> However, a prerequisite condition for valid ordinary-least-squares regression analysis is that the residual returns have the same volatility throughout the entire estimation period. This condition is called homoskedasticity. If residual return volatility is not constant, that alternative condition is called heteroskedasticity, a complexity in the data that requires a more advanced regression estimation procedure.
132. In the instant matter, the Class Period spans a part of the Covid-19 pandemic, during which many stocks exhibited elevated volatility.<sup>74</sup> It is likely that the Class Period regressions would exhibit heteroskedasticity and potentially other econometric issues.
133. To accommodate and correct for the likely presence of heteroskedasticity (which is non-constant volatility among the residual returns), I also ran all regressions and tested for statistical significance applying the Newey-West procedure, which accommodates changing volatility by estimating the applicable volatility for each test date.<sup>75</sup> The Newey-West-estimated volatility converges to its true value, so that the procedure is “robust” to

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<sup>73</sup> “Event-Study Analysis,” by John Campbell et al., Chapter 4 of *The Econometrics of Financial Markets*, Princeton University Press, 1997.

<sup>74</sup> On 30 January 2020, the Director-General of the World Health Organization declared the novel coronavirus outbreak a Public Health Emergency of International Concern. “WHO Director-General’s statement on IHR Emergency Committee on Novel Coronavirus (2019-nCoV),” speech transcript, World Health Organization, 30 January 2020, [https://www.who.int/director-general/speeches/detail/who-director-general-s-statement-on-ihr-emergency-committee-on-novel-coronavirus-\(2019-ncov\)](https://www.who.int/director-general/speeches/detail/who-director-general-s-statement-on-ihr-emergency-committee-on-novel-coronavirus-(2019-ncov)); and “Statement on the Second Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Outbreak of Novel Coronavirus (2019-nCoV),” World Health Organization, 30 January 2020, [https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)).

<sup>75</sup> “A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix,” by Whitney Newey and Kenneth West, *Econometrica*, vol. 55, no. 3, 1987, pp. 703-708; *A Guide to Econometrics*, by Peter Kennedy, 6<sup>th</sup> ed., Blackwell Publishing, 2008, p. 343; and *Introduction to Econometrics*, by James Stock and Mark Watson, 3<sup>rd</sup> ed., Pearson, 2015, p. 545.

heteroskedasticity. There was no qualitative difference between the test results produced using the Newey-West procedure versus OLS.

134. The regression results are presented in Exhibit-8.

## 6. *t*-Test

135. For all days during the Class Period, I conducted a statistical test called a *t*-test to determine whether the residual return of Pega stock was statistically significant. Statistical significance for an event date means that the event day return, after controlling for the overall stock market and industry sector effects, was of such magnitude that it cannot reasonably be attributed to random volatility but must have been caused by Company-specific information.
136. A *t*-test compares the residual return on an event date to the typical residual returns exhibited over the regression estimation period. When applying the Newey-West procedure, the *t*-test makes use of the estimated level of random volatility. If the event date residual return is far greater (positively or negatively) than the typical residual return, and exceeds the threshold where volatility could reasonably be the sole cause of the residual return, then the *t*-test indicates that the event residual return is deemed statistically significant.<sup>76</sup> Statistical significance of a tested information event means that the event return could not reasonably have been caused by random volatility, so, with market and sector factors also accounted for, the residual stock price movement must have been caused by information about the company.

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<sup>76</sup> This test is called the *t*-test because it involves the computation of a *t*-statistic, which is the event day residual return divided by the estimated standard deviation of the residual return. If the absolute value of the *t*-statistic is greater than the critical *t*-statistic value (1.96 for large samples), the likelihood that the residual return could have been caused by random volatility alone is less than 5%. This is generally accepted to be so unlikely that the random volatility explanation can be rejected, and the stock return for that day is deemed statistically significant at the 95% confidence level. If the absolute value of the *t*-statistic is greater than the critical *t*-statistic value of 2.58 for large samples, the likelihood that the residual return could have been caused by random volatility alone is less than 1%, and the security return for that day is deemed statistically significant at the 99% confidence level.

137. The results of the event study for the earnings announcement event dates are summarized below and presented in Exhibit-9. Exhibit-10 presents the event study results for all dates during the Class Period.<sup>77</sup>
138. Exhibit-9 shows that five of Pega's eight earnings announcements during the Class Period elicited statistically significant price reactions at the 95% confidence level or higher. As explained below, five of eight earnings announcements eliciting statistically significant price reactions indicates market efficiency.

### **C. Collective Event Study Test Results**

139. The Class Period comprised 479 trading days, of which eight days were earnings announcement event dates. Five of the eight earnings announcement event days elicited statistically significant returns, which is an incident rate of 62.50%. Of the remaining 471 trading days in the Class Period, deemed only for purposes of this test to be non- or lesser-news days (as they were not earnings announcement days), 26 were statistically significant, which is an incidence rate of 5.52%.
140. Clearly, there was a much greater frequency rate of statistically significant Pega stock returns on earnings announcement event dates than on all other more ordinary days (62.50% versus 5.52%). I conducted a statistical test to determine whether five of eight earnings announcements during the Class Period eliciting statistically significant stock price reactions was frequent enough to indicate market efficiency. The statistical test, known as the Fisher Exact Test, determines whether five significant stock returns out of eight earnings announcement events could have been the result of random chance alone, or alternatively, must have been caused by a cause-and-effect relationship between the release of Company information and Pega stock price movements.
141. The Fisher Exact Test is a commonly used and widely accepted statistical methodology for testing whether incidence rates are meaningfully different between two groups of data or dates. A higher incidence of statistically significant returns on earnings announcement event dates relative to all other dates would indicate that that Pega stock responded to

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<sup>77</sup> The regression results for the Examination Period are presented in Exhibit-11. The results of the event study for the earnings announcement event dates in the Examination Period are presented in Exhibit-12. Exhibit-13 presents the event study results for all dates during the Examination Period.

information and thereby demonstrated market efficiency. If information about Pega was ignored by investors, or the market infrastructure was such that the information could not be impounded into the stock price, the incidence of significant returns for the earnings announcement events would be similar to the incidence rate for the non-event days. But, this was not the case.

142. The Fisher Exact Test finds that the difference in the incidence of statistical significance for the earnings announcement event days versus the non-event days, 62.50% versus 5.52%, is itself highly statistically significant, and could not reasonably have happened by random chance alone. The earnings announcement event days did, in fact, exhibit a *significantly* greater incidence of statistically significant returns compared to all other days.
143. The probability that five of eight earnings announcement event days would be statistically significant if Pega stock did not respond to information (such that Pega stock behaved the same on news- and non-news days) is only 0.0040%.<sup>78</sup> Therefore, with a confidence level greater than 99.99%, this finding rejects the null hypothesis that the Pega stock behaved no differently on earnings announcement event days with a greater flow of information than on all other days. The conclusion is that the Pega stock reacted to information and therefore the market for Pega stock demonstrated informational efficiency during the Class Period.
144. To check for robustness, I re-ran the Fisher Exact Test using the Newey-West regression estimation procedure for the Class Period. Using the Newey-West regression estimates, I find the same number of events significant in the earnings announcement event days and the non- or lesser- news days as when using the OLS regression estimates. Therefore, with a confidence level greater than 99.99%, this finding rejects the null hypothesis that Pega stock behaved no differently on earnings announcement event days with a greater flow of information than on all other days.<sup>79</sup>

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<sup>78</sup> Using the Ordinary Least Squares regression estimates for the Examination Period, there are six out of nine earnings announcement event days significant (66.67%), and 33 out of 559 non- or lesser- news days significant (5.90%). The probability that six of nine earnings announcement event days would be statistically significant if Pega stock did not respond to information is only 0.0005%. Therefore, with a confidence level greater than 99.99%, this finding rejects the null hypothesis that Pega stock behaved no differently on earnings announcement event days with a greater flow of information than on all other days.

<sup>79</sup> To check for robustness, I re-ran the Fisher Exact Test using the Newey-West regression estimation procedure for the Examination Period. Using the Newey-West regression estimates, I find the same number of events significant in

## IX. MARKET EFFICIENCY SUMMARY

145. Pega stock traded on the Nasdaq with numerous market makers facilitating trading in the stock. Trading volume was at the level warranting a strong presumption of market efficiency. The Company was widely covered by analysts and the news media. Institutional ownership of Pega stock was widespread. The Company qualified for Form S-3 registration, possessing the eligibility attributes that indicate market efficiency. Market capitalization and float were large compared to other publicly traded companies. The stock's bid-ask spread was narrower than the average bid-ask spread among all other stocks traded on U.S. exchanges. No impediments to market efficiency were present.
146. Pega stock also satisfied the empirical *Cammer* factor, observably reacting to information flow, thereby demonstrating market efficiency. The collective event study test proved that there was a cause-and-effect relationship between new, Company-specific information and movements in the price of Pega stock.
147. In sum, the market for Pega stock satisfied all of the *Cammer* and *Krogman* factors, which indicate market efficiency. Given these facts, I conclude that Pega stock traded in an efficient market over the course of the Class Period.<sup>80</sup>

## X. COMMON DAMAGES METHODOLOGY

148. Counsel for the Plaintiffs asked me to opine on whether Section 10(b) per-share damages can be measured for all Class members using a common Class-wide methodology that is consistent with Plaintiffs' theory of liability.
149. Section 10(b) addresses liability for investor losses sustained in connection with the purchase or sale of securities as a result of fraudulent material misrepresentations and omissions.

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the earnings announcement event days and the non- or lesser- news days as when using the OLS regression estimates. Therefore, with a confidence level greater than 99.99%, this finding rejects the null hypothesis that Pega stock behaved no differently on earnings announcement event days with a greater flow of information than on all other days.

<sup>80</sup> The market for Pega stock similarly satisfied all of the *Cammer* and *Krogman* factors during the Examination Period. Given these facts, I conclude that Pega stock traded in an efficient market over the course of the Examination Period.

150. It should be noted that I have not conducted a loss causation analysis or computed damages as of this time, nor have I been asked to do so. If asked, I will do so at the appropriate stage of this litigation. The full loss causation analysis that will be necessary to calculate damages in the current case requires the full development of the factual record.
151. The out-of-pocket damages methodology discussed herein is consistent with Plaintiffs' theory of liability and can be applied commonly for all Class members. The out-of-pocket damages methodology is used to compute damages in virtually all securities class action cases. It has been acknowledged as the appropriate damages model in numerous class action securities cases<sup>81</sup> and in published legal scholarship.<sup>82</sup>
152. Artificial inflation is the difference between the observed market price of the stock and what that stock price would have been but for the misrepresentations and omissions. An investor who buys a stock that is artificially inflated is overpaying by the amount of the artificial inflation in the stock. Out-of-pocket damages are the amount the investor overpaid for the stock on account of the misrepresentations and omissions, less any artificial inflation they recovered upon sale or disposition of the stock. Therefore, out-of-pocket damages are measured as the difference between the amount of stock price inflation at purchase and the amount of inflation in the stock price at sale or, if held, at the end of the Class Period. The out-of-pocket method of calculating damages also takes into account formulaic prescriptions in relevant case law and statutes.

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<sup>81</sup> See, e.g., *City of Miami Gen. Empls. & Sanitation Empls.' Ret. Tr. v. RH, Inc.*, No. 17-cv-00554-YGR, 2018 WL 4931543, at \*3 (N.D. Cal. Oct. 11, 2018) ("Courts regularly reaffirm that the out-of-pocket, or event study, method matches plaintiffs' theory of liability under Section 10(b) of the Securities Exchange Act, making it the standard method for calculating damages in virtually every Section 10(b) class action."); *In re Acuity Brands, Inc. Sec. Litig.* 2020 WL 5088092, at \*7 (N.D. Ga. Aug. 25, 2020) (acknowledging that the defendant's expert agreed that out-of-pocket damages is "the most common method for calculating economic damages in a Rule 10b-5 matter" and is in accordance with recent Supreme Court case law); *City of Sunrise Gen. Empls.' Ret. Plan v. FleetCor Techs., Inc.*, 2019 WL 3449671, at \*6 (N.D. Ga. July 17, 2019) (endorsing plaintiff's expert's assertion that "the standard and well-settled formula for assessing damages for each class member under Section 10(b) is the 'out-of-pocket' method"); *Weiner v. Tivity Health, Inc.*, 334 F.R.D. 123, 137 (M.D. Tenn. Jan. 29, 2020); *Dougherty v. Esperion Therapeutics, Inc.*, No. 16-10089, 2020 WL 2832252, at \*6 (E.D. Mich. May 31, 2020), report and recommendation adopted, No. 16-10089, 2020 WL 6793326 (E.D. Mich. Nov. 19, 2020).

<sup>82</sup> See, e.g., "Cause for Concern: Causation and Federal Securities Fraud," by Jill Fisch, *Iowa Law Review*, vol. 94, 2009; and "Use of Modern Finance Theory in Securities Fraud Cases Involving Actively Traded Securities," by Daniel Fischel, *The Business Lawyer*, vol. 38, no. 1, 1982 ("Isolating the effect of the alleged misconduct on the firm's stock price is required by the out-of-pocket measure of damages, the traditional method for computing damages in open market trading cases under the rule 10b-5, which limits recovery to the difference between the price paid or received, and the 'real' value of the security at the time of the purchase/sale.").



153. This damage computation methodology allows the calculation of individual and Class-wide damages stemming from various alleged misrepresentations and omissions. The methodology therefore accommodates alternative potential determinations of liability with respect to specific alleged misrepresentations and omissions. Economic analyses, including valuation and empirical event study analysis, can be used to estimate the relationship between specific statements or sets of statements and the subsequent effect on stock prices. This applies to affirmative statements, omissions, and/or corrective disclosures. As such, Class-wide damages in response to the specific misrepresentations and omissions ultimately established by Plaintiffs can be calculated in a straightforward manner common to all Class members.
154. To the extent that there may be specific issues complicating the quantification of artificial inflation encountered in the execution of the out-of-pocket damages methodology due to any potentially unique facts and circumstances of this case, the standard tools of valuation analysis can be applied as needed to value Pega stock in the but-for scenario, and that but-for price can then be compared with the actual prevailing market price to arrive at the measure of artificial inflation. That is, the standard array of valuation tools commonly used to value securities can be applied to measure what the price of Pega stock would have been but-for the alleged misrepresentations and omissions, and that but-for valuation would determine how much artificial inflation was in the observed market price.
155. Valuation analysis is undertaken continuously, every day, for virtually every publicly traded security, and these tools address the very complexities that could potentially be encountered in the course of computing inflation and damages in this case. Valuations assuming alternative scenarios are commonly conducted by analysts and investors.
156. Among the commonly used valuation tools that are available to investors, analysts in real time, and forensic analysts when computing damages, are, for example: valuation multiple models, such as those based on earnings, earnings before interest, tax, depreciation and amortization (EBITDA), revenue, book value, and cash flow; discounted cash flow (DCF) models; scenario analysis, and the literature regarding valuation effects of factors such as reputation, transparency, governance, and the quality of internal controls. In addition, forensic analysts have the added advantage of being able to use event study analysis, which quantifies the price effects that occurred when information did reach the market.



157. Assuming that the Court finds a verdict in favor of Plaintiffs on the allegations of fraud, Section 10(b) per-share damages can be measured as follows:
- i. First, valuation tools, which would include event study analysis, and potentially other empirical analyses, if necessary, would be used to establish if the disclosure(s) correcting the alleged misrepresentations and omissions caused the price of Pega stock to fall. This analysis, after controlling for potentially non-fraud-related information, would establish whether the alleged misrepresentations and omissions had caused the stock price to be artificially inflated, and if a corrective disclosure caused that artificial inflation to dissipate, in turn causing investor losses. This analysis would apply on a Class-wide basis.
  - ii. Second, an inflation ribbon would be constructed, using generally accepted empirical analysis and valuation tools, indicating how much artificial inflation caused by the alleged misrepresentations and omissions was in the price of Pega stock on each day during the Class Period, if any. An inflation ribbon is a time series of the difference between a stock's actual price observed in the marketplace, and the estimated price that the stock would have traded at each day had there been full disclosure. Construction of the inflation ribbon generally employs event study analysis, combined with widely used and generally accepted valuation tools. The inflation ribbon is often constructed by working chronologically backwards from the final corrective disclosure back to the start of the Class Period, accounting for alleged fraud-related residual price declines as they occurred. Inflation prior to a corrective disclosure that dissipated inflation is greater than the inflation afterward by the amount of inflation that dissipated. The corrective disclosure that finally eliminates all remaining artificial inflation may occur at or after the end of the Class Period.
  - iii. Supplementing event study results, the full array of generally accepted and widely used valuation tools can be applied, if necessary, to calculate the but-for stock prices under the assumption of prior full disclosure. This analysis enables computation of the artificial inflation ribbon even in cases where there is confounding information, changes in the concealed information, and changes in the value of the concealed information, among other potential complexities. This

analysis would also apply on a Class-wide basis. My reading of Plaintiffs' allegations and my review of the experience of the Company over the course of the Class Period uncovered no facts or circumstances that are extraordinarily unusual or might make application of this methodology exceptionally difficult.

- iv. Third, the measure of per-share damages generally applied in Section 10(b) cases is the reduction in the inflation ribbon over an investor's holding period (the economic/inflation loss). That is, for each Class member, per-share damages would be calculated as the difference between the inflation on the date the shares were purchased and the inflation on the date those same shares were subsequently sold.
  - v. Per-share damages are limited, however, to be no greater than the decline in the share price over the investor's holding period, which is the investment loss actually sustained.
  - vi. Pursuant to the Private Securities Litigation Reform Act of 1995 (15 U.S.C. § 78u-4(e)), for purposes of computing the investment loss limitation on damages, for any shares sold during the 90-day period after the final corrective disclosure, the investment loss is computed as if the selling price was the greater of the actual selling price or the average closing price following the final corrective disclosure up to the sale date. For any shares held 90 days or more beyond the final corrective disclosure, the investment loss is computed as if the shares were sold for the average closing price over the 90 days following the final corrective disclosure.
  - vii. The calculation of each Class member's per-share damages would be a mechanical arithmetic exercise for all Class members who bought Pega stock during the Class Period, conducted the same way for all Class members, applying the results of the Class-wide analyses described above to each Class member's stock trading data.
158. In the instant case, just as in virtually all Section 10(b) class action securities cases, damages for all Class members can be computed in the same way, applying this common methodology to all Class members, using the out-of-pocket damages model, in accordance with widely used and generally accepted methodology and common analytics, and readily available daily pricing information for Pega stock. This damages computation methodology is consistent not only with Plaintiffs' theory of liability, but also with governing statutes and case law.

159. I have not yet been asked to calculate damages. The exact damages calculations will depend, in part, on the completion of discovery and full development of the factual record in this case. However, any valuation or computational complexities that may be encountered in the execution of the damage methodology will affect all Class members commonly, and therefore will be addressed in a common fashion. The methodology described above is generally accepted and widely used for calculating damages under Section 10(b) for all Class members in securities class actions.

**XI. LIMITING FACTORS AND OTHER ASSUMPTIONS**

160. This report is furnished solely for the purpose of court proceedings in the above-referenced matter and may not be used or referred to for any other purpose. The analysis and opinions contained in this report are based on information available as of the date of the report. I reserve the right to amend, refine, or supplement this report in the event that I become aware of additional information, evidence, arguments, or analyses which bear on my work in this matter.



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Steven P. Feinstein, Ph.D., CFA

## XII. APPENDIX-1: LOGARITHMIC RETURNS

A1-1. Logarithmic returns, rather than percent change returns, are commonly used in stock return regressions and event study analysis and were used in the regression modeling here. The formula for a logarithmic return is:

$$R_t = \ln\left(\frac{P_t + d_t}{P_{t-1}}\right)$$

where:

$R_t$  is the logarithmic return on day  $t$ ;  
 $P_t$  is the stock price at the end of day  $t$ ;  
 $P_{t-1}$  is the stock price from the previous day, day  $t-1$ ;  
 $d_t$  is the dividend on day  $t$ , if any.

A1-2. The formula for converting a logarithmic return into a dollar return is:

$$DR_t = P_{t-1} \cdot (e^{R_t} - 1)$$

where:

$DR_t$  is the dollar return on day  $t$ ;  
 $P_{t-1}$  is the stock price from the previous day, day  $t-1$ ;  
 $e$  is natural  $e$  (approximately 2.7);  
 $R_t$  is the logarithmic return on day  $t$ .

A1-3. If a stock price falls from \$20 to \$18, the percent change in price is -10%, equal to the \$2 decline divided by the original \$20 price. The logarithmic return, however, is -10.54%, equal to  $\ln(\$18/\$20)$ .

A1-4. The logarithmic return relates a price change to an average of the original, final, and intervening prices over the course of a price decline. As such, for large price declines, it is possible for a logarithmic price decline to exceed 100%, since the price decline may be greater than the average of the beginning and ending prices.

A1-5. An attractive feature of a logarithmic return is that it can be decomposed into contributing factors linearly. That is, the portion of a logarithmic return caused by company-specific information is isolated by subtracting from the total logarithmic return the portion of the total return caused by market and sector factors.

**Exhibit-1**  
**Documents and Other Information Considered**

**CASE LEGAL DOCUMENTS**

- Lead Plaintiffs' Consolidated Amended Complaint for Violations of the Federal Securities Laws, filed 18 October 2022.
- Memorandum and Order, filed 24 July 2023.

**NEWS ARTICLES AND PRESS RELEASES**

- Factiva news articles from 16 June 2019 to 9 May 2023, downloaded using the following search parameters: All Sources; All Authors; Company: Pegasystems Inc.; All Subjects; All Industries; All Regions.
- "Pega Cloud Revenue and ACV grow by more than 50%," *PR Newswire*, 28 July 2020, 4:05 PM.
- "Pega Cloud Continues to Expand in Third Quarter of 2020," *PR Newswire*, 28 October 2020, 4:05 PM.
- "Cloud Growth Drives Pega Through \$1 Billion Milestone in 2020," *PR Newswire*, 17 February 2021, 4:05 PM.
- "Digital Transformation Demand Increases Pega Cloud Revenue 56 percent in Q1 2021," *PR Newswire*, 28 April 2021, 4:05 PM.
- "Pega continues strong first-half momentum through Q2 2021," *PR Newswire*, 28 July 2021, 4:05 PM.
- "Pega continues accelerated growth through Q3 2021," *PR Newswire*, 27 October 2021, 4:05 PM.
- "Annual contract value exceeds \$1 billion in Q4 2021," *PR Newswire*, 16 February 2022, 4:05 PM.
- "Annual contract value grows 21 percent as profitability improves in Q1 2022," *PR Newswire*, 28 April 2022, 4:05 PM.
- "Client Adoption Drives Pega Cloud to 70% of New Client Commitments in First Half of 2022," *PR Newswire*, 27 July 2022, 4:05 PM.

**ANALYST REPORTS**

- Analyst reports, 1 January 2019 through 19 September 2022, in the following files:
  - GS-000001-GS-000530
  - KBCM000001-KBCM006105
  - LOOP0000001-LOOP0000532
  - NEEDHAM000001-NEEDHAM000476
  - PEGA analyst reports 01012019-12312020

**Exhibit-1**  
**Documents and Other Information Considered**

- PEGA analyst reports 01012021-07192022
- PEGA analyst reports 07202022-08232022
- PEGA analyst reports 08242022-0919202

**SEC FILINGS**

- Pegasystems Inc., Form 8-K, filed 7 February 2020.
- Pegasystems Inc., Form 8-K, filed 12 February 2020.
- Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2019, filed 12 February 2020.
- Pegasystems Inc., Form SC 13G/A, filed 13 February 2020.
- Pegasystems Inc., Form 8-K, filed 18 February 2020.
- Pegasystems Inc., Form 8-K, filed 20 February 2020.
- Pegasystems Inc., Form 8-K, filed 24 February 2020.
- Pegasystems Inc., Form 8-K, filed 9 March 2020.
- Pegasystems Inc., Form DEFA14A, filed 29 April 2020.
- Pegasystems Inc., Form DEF 14A, filed 29 April 2020.
- Pegasystems Inc., Form 8-K, filed 29 April 2020.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 31 March 2020, filed 29 April 2020.
- Pegasystems Inc., Form 8-K, filed 29 April 2020.
- Pegasystems Inc., Form DEFA14A, filed 4 June 2020.
- Pegasystems Inc., Form 8-K, filed 15 June 2020.
- Pegasystems Inc., Form 8-K, filed 24 June 2020.
- Pegasystems Inc., Form S-8, filed 16 July 2020.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 30 June 2020, filed 28 July 2020.
- Pegasystems Inc., Form 8-K, filed 28 July 2020.
- Pegasystems Inc., Form CORRESP, filed 17 September 2020.
- Pegasystems Inc., Form UPLOAD, filed 24 September 2020.
- Pegasystems Inc., Form UPLOAD, filed 22 October 2020.
- Pegasystems Inc., Form CORRESP, filed 22 October 2020.
- Pegasystems Inc., Form 8-K, filed 28 October 2020.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 30 September 2020, filed 28 October 2020.
- Pegasystems Inc., Form 8-K, filed 8 February 2021.
- Pegasystems Inc., Form SC 13G, filed 8 February 2021.
- Pegasystems Inc., Form SC 13G/A, filed 12 February 2021.
- Pegasystems Inc., Form SC 13G, filed 16 February 2021.

**Exhibit-1**  
**Documents and Other Information Considered**

- Pegasystems Inc., Form 10-K for the fiscal year ended 31 March 2020, filed 17 February 2021.
- Pegasystems Inc., Form 8-K, filed 17 February 2021.
- Pegasystems Inc., Form 8-K, filed 8 March 2021.
- Pegasystems Inc., Form 8-K, filed 28 April 2021.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 31 March 2021, filed 28 April 2021.
- Pegasystems Inc., Form DEFA14A, filed 29 April 2021.
- Pegasystems Inc., Form DEF 14A, filed 29 April 2021.
- Pegasystems Inc., Form 8-K, filed 3 June 2021.
- Pegasystems Inc., Form 8-K, filed 8 June 2021.
- Pegasystems Inc., Form DEFA14A, filed 15 June 2021.
- Pegasystems Inc., Form 8-K, filed 28 June 2021.
- Pegasystems Inc., Form 8-K, filed 9 July 2021.
- Pegasystems Inc., Form 8-K, filed 28 July 2021.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 30 June 2021, filed 28 July 2021.
- Pegasystems Inc., Form 8-K, filed 27 October 2021.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 30 September 2021, filed 27 October 2021.
- Pegasystems Inc., Form 8-K, filed 22 December 2021.
- Pegasystems Inc., Form 8-K, filed 7 February 2022.
- Pegasystems Inc., Form SC 13G/A, filed 14 February 2022.
- Pegasystems Inc., Form SC 13G/A, filed 14 February 2022.
- Pegasystems Inc., Form SC 13G/A, filed 14 February 2022.
- Pegasystems Inc., Form SC 13G/A, filed 15 February 2022.
- Pegasystems Inc., Form 8-K, filed 16 February 2022.
- Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2021, filed 16 February 2022.
- Pegasystems Inc., Form 8-K, filed 7 March 2022.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 31 March 2022, filed 28 April 2022.
- Pegasystems Inc., Form 8-K, filed 28 April 2022.
- Pegasystems Inc., Form DEF 14A, filed 29 April 2022.
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- Pegasystems Inc., Form 8-K, filed 9 May 2022.
- Pegasystems Inc., Form 8-K, filed 10 May 2022.
- Pegasystems Inc., Form 8-K, filed 12 May 2022.
- Pegasystems Inc., Form 8-K, filed 2 June 2022.
- Pegasystems Inc., Form 8-K, filed 24 June 2022.

**Exhibit-1**  
**Documents and Other Information Considered**

- Pegasystems Inc., Form 8-K, filed 27 July 2022.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 30 June 2022, filed 27 July 2022.
- Pegasystems Inc., Form 8-K, filed 16 September 2022.
- Pegasystems Inc., Form 10-Q for the quarterly period ended 30 September 2022, filed 26 October 2022.
- Pegasystems Inc., Form 8-K, filed 26 October 2022.
- Pegasystems Inc., Form 8-K, filed 10 November 2022.
- Pegasystems Inc., Form 8-K, filed 5 December 2022.
- Pegasystems Inc., Form 8-K, filed 3 January 2023.
- Pegasystems Inc., Form 8-K, filed 7 February 2023.
- Pegasystems Inc., Form SC 13G, filed 9 February 2023.
- Pegasystems Inc., Form 8-K, filed 13 February 2023.
- Pegasystems Inc., Form SC 13G/A, filed 14 February 2023.
- Pegasystems Inc., Form SC 13G/A, filed 14 February 2023.
- Pegasystems Inc., Form SC 13G/A, filed 14 February 2023.
- Pegasystems Inc., Form 8-K, filed 15 February 2023.
- Pegasystems Inc., Form 10-K for the fiscal year ended 31 December 2022, filed 15 February 2023.

**CONFERENCE CALL TRANSCRIPTS**

- “Q2 2020 Pegasystems Inc Earnings Call,” *Refinitiv*, conference call, 28 July 2020.
- “Pegasystems Inc to Hold Virtual Investor Session,” *Refinitiv*, conference call, 25 August 2020.
- “Q3 2020 Pegasystems Inc Earnings Call,” *Refinitiv*, conference call, 28 October 2020.
- “Q4 2020 Pegasystems Inc Earnings Call,” *Refinitiv*, conference call, 17 February 2021.
- “Q1 2021 Pegasystems Inc Earnings Call,” *Refinitiv*, conference call, 28 April 2021.
- “Pegasystems Inc to Hold Investor Session,” *Refinitiv*, conference call, 3 June 2021.
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- “Q3 2021 Pegasystems Inc Earnings Call,” *Refinitiv*, conference call, 27 October 2021.
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- “Pegasystems Inc Investor Day,” *Refinitiv*, conference call, 2 June 2022.
- “Q2 2022 Pegasystems Inc Earnings Call,” *Refinitiv*, conference call, 27 July 2022.
- “Q3 2022 Pegasystems Inc Earnings Call,” *Refinitiv*, conference call, 27 October 2022.



**Exhibit-1**  
**Documents and Other Information Considered**

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**Exhibit-1**  
**Documents and Other Information Considered**

- Patell, James and Mark Wolfson, “The Intraday Speed of Adjustment of Stock Prices to Earnings and Dividend Announcements,” *Journal of Financial Economics*, vol. 13, no. 2, 1984.
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- Villanueva, Miguel and Steven Feinstein, “Stock Price Reactivity to Earnings Announcements: The Role of the Cammer/Krogman Factors,” *Review of Quantitative Finance and Accounting*, vol. 57, no. 1, 2021.
- Watts, Ross, “Systematic ‘Abnormal’ Returns after Quarterly Earnings Announcements” *Journal of Financial Economics*, vol. 6, no. 2, 1978.

**DATA AND DATABASES**

- Bloomberg
- CRSP (Center for Research in Security Prices)
- EDGAR
- Factiva
- Refinitiv Eikon
- S&P Global

**LEGAL CASES**

- *Amgen Inc. v. Connecticut Retirement Plans and Trust Funds*, 568 U.S. 455 (2013).
- *Appian Corporation v. Pegasystems Inc.*, et al., Civil Action No. 2020-07216, Circuit Court of Fairfax County, Virginia, 29 May 2020.
- *Basic, Inc. v. Levinson*, 485 U.S. 224 (1988).
- *Cammer v. Bloom*, 711 F. Supp. 1264 (D.N.J. 1989).
- *Cheney v. Cyberguard Corp.*, 213 F.R.D. 484, (S.D. Fla. 2003).
- *City of Cape Coral Municipal Firefighters’ Retirement Plan v. Emergent Biosolutions, Inc.*, HQ, 322 F. Supp. 3d 676 (D. Md. 2018).
- *City of Miami Gen. Empls. & Sanitation Empls.’ Ret. Tr. v. RH, Inc.*, No. 17-cv-00554-YGR, 2018 WL 4931543 (N.D. Cal. Oct. 11, 2018).
- *City of Sunrise Gen. Empls.’ Ret. Plan v. FleetCor Techs., Inc.*, 2019 WL 3449671 (N.D. Ga. July 17, 2019).
- *Comcast Corp. v. Behrend*, 569 U.S. 27, 35 (2013).

**Exhibit-1**  
**Documents and Other Information Considered**

- *Dougherty v. Esperion Therapeutics, Inc.*, No. 16-10089, 2020 WL 2832252 (E.D. Mich. May 31, 2020), report and recommendation adopted, No. 16-10089, 2020 WL 6793326 (E.D. Mich. Nov. 19, 2020).
- *Halliburton Co. v. Erica P. John Fund, Inc.*, 573 U.S. 258 (2014).
- *In re Acuity Brands, Inc. Sec. Litig.* 2020 WL 5088092 (N.D. Ga. Aug. 25, 2020).
- *In re Alstom SA Securities Litigation*, 253 F.R.D. 266 (S.D.N.Y. 2008).
- *In re Aveo Pharms., Inc. Sec. Litig.*, Civil Action No. 13-11157 (D. Mass. Nov. 14, 2017).
- *In Re Banc of California Securities Litigation*, 326 F.R.D. 640 (C.D. Cal. 2018).
- *In re Petrobras Securities Litigation*, 312 F.R.D. 354 (S.D.N.Y. 2016).
- *Krogman v. Sterritt*, 202 F.R.D. 467 (N.D. Tex. 2001).
- *Lehocky v. Tidel Technologies, Inc.*, 220 F.R.D. 491 (S.D. Tex. 2004).
- *Levy v. Gutierrez*, 448 F. Supp. 3d 46 (D.N.H. 2019).
- *McIntire v. China MediaExpress Holdings, Inc.*, 38 F. Supp. 3d 415 (S.D.N.Y. 2014).
- *Smilovits v. First Solar, Inc.*, 295 F.R.D. 423 (D. Ariz. 2013).
- *Unger v. Amedisys, Inc.*, 401 F.3d 316 (5<sup>th</sup> Cir. 2005).
- *Waggoner v. Barclays PLC*, 875 F.3d 79 (2d Cir. 2017).
- *Weiner v. Tivity Health, Inc.*, 334 F.R.D. 123 (M.D. Tenn. Jan. 29, 2020).

**OTHER**

- 17 CFR § 229.201.
- Section 10(b) of the Securities Exchange Act of 1934.
- Private Securities Litigation Reform Act of 1995 (15 U.S.C. § 78u-4(e)).
- “Revisions to the Eligibility Requirements for Primary Securities Offerings on Forms S-3 and F-3,” SEC Release No. 33-8812, 20 June 2007.
- “Revisions to the Eligibility Requirements for Primary Securities Offerings on Forms S-3 and F-3,” SEC Release No. 33-8878, 19 December 2007.
- Brief of Financial Economists as *Amici Curiae* in Support of Respondents, *Halliburton Co. and David Lesar v. Erica P. John Fund, Inc.*, Case No. 13-317 (U.S. Supreme Court), 5 February 2014.
- Brief of Testifying Economists as *Amici Curiae* in Support of Respondent, *Halliburton Co. and David Lesar v. Erica P. John Fund, Inc.*, Case No. 13-317 (U.S.), 5 February 2014.
- “WHO Director-General’s statement on IHR Emergency Committee on Novel Coronavirus (2019-nCoV),” speech transcript, World Health Organization, 30 January 2020, accessed at [https://www.who.int/director-general/speeches/detail/who-director-general-s-statement-on-ihr-emergency-committee-on-novel-coronavirus-\(2019-ncov\)](https://www.who.int/director-general/speeches/detail/who-director-general-s-statement-on-ihr-emergency-committee-on-novel-coronavirus-(2019-ncov)); and “Statement on the Second Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Outbreak of Novel Coronavirus (2019-nCoV),”

**Exhibit-1**

**Documents and Other Information Considered**

World Health Organization, 30 January 2020, [https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)).

- Any other documents cited in the report.

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

Babson College  
Finance Division  
Babson Park, MA 02457  
781-239-5275  
Feinstein@Babson.edu

**EDUCATION**

- 1989 YALE UNIVERSITY  
Ph.D. in Economics (Concentration in Finance)
- 1986 YALE UNIVERSITY  
M.Phil. in Economics
- 1983 YALE UNIVERSITY  
M.A. in Economics
- 1981 POMONA COLLEGE  
B.A. in Economics (Phi Beta Kappa, *cum laude*)

**TEACHING EXPERIENCE**

- 1996 - present      BABSON COLLEGE  
Babson Park, MA  
Full-time Faculty, Finance Division  
Associate Professor (2000-present)  
Donald P. Babson Chair in Applied Investments (2002-2010)  
Faculty Director of the Babson College Fund (2002-2009)  
Director of the Stephen D. Cutler Investment Management  
Center  
(2002-2007)  
Assistant Professor (1996-2000)
- 1990 - 1995      BOSTON UNIVERSITY SCHOOL OF MANAGEMENT  
Boston, MA  
Full-time Faculty, Department of Finance

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

1993 - 1994      WASHINGTON UNIVERSITY, OLIN SCHOOL OF  
BUSINESS  
St. Louis, MO  
Visiting Assistant Professor, Department of Finance

**BUSINESS EXPERIENCE**

2008 - present      CROWNINSHIELD FINANCIAL RESEARCH, INC.  
Brookline, MA  
President and Senior Expert

1996 - 2008      THE MICHEL-SHAKED GROUP  
Boston, MA  
Senior Expert (2001 - 2008)  
Affiliated Expert (1996 - 2001)

1987 - 1990      FEDERAL RESERVE BANK OF ATLANTA  
Economist

**PROFESSIONAL DESIGNATIONS**

1998    Awarded the Chartered Financial Analyst designation by the Association for  
Investment Management and Research.

**RESEARCH AWARDS**

1999    Greater Boston Real Estate Board/Real Estate Finance Association –  
Research Grant and Featured Speaker at Real Estate Finance Association  
Meetings.

**PAPERS AND PUBLICATIONS**

“Securities Litigation Event Studies in the Covid Volatility Regime,” (with  
Miguel Villanueva) *Journal of Forensic Economics*, vol. 30, no. 1, 2022.

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

“Stock Price Reactivity to Earnings Announcements: The Role of the Cammer/Krogman Factors,” (with Miguel Villanueva) *Review of Quantitative Finance and Accounting*, vol. 57, no. 1, 2021.

“What A Solar Eclipse Has To Do With Market Efficiency,” (with Daniel Bettencourt) *Law360.com*, 2017.

“Underestimation of Securities Fraud Aggregate Damages Due to Inter-Fund Trades,” (with Gang Hu, Mark Marcus, and Zann Ali) *Journal of Forensic Economics*, September 2013, Vol. 24, No. 2, 161-173.

“Lehman Equity Research Tipping: Evidence in the Stock Price Data,” Working paper, March 2010. Cited in *New York Times* May 19, 2012, and made available on the *New York Times* website.

“Distortion in Corporate Valuation: Implications of Capital Structure Changes,” (with Allen Michel and Jacob Oded) *Managerial Finance*, 2011, Vol. 37(8), 681-696.

“Market Signals of Investment Unsuitability,” (with Alexander Liss and Steven Achatz) *Law360.com*, June 3, 2010. Available from <http://www.law360.com/articles/170690>.

“Planning Capital Expenditure,” in *The Portable MBA in Financing and Accounting*, J. L. Livingstone and T. Grossman, editors, New York: Wiley, 3<sup>rd</sup> edition 2001, and 4<sup>th</sup> edition 2009.

“Financial Management of Risks,” in *The Portable MBA in Financing and Accounting*, J. L. Livingstone and T. Grossman, editors, New York: Wiley, 2<sup>nd</sup> edition 1997, 3<sup>rd</sup> edition 2001, and 4<sup>th</sup> edition 2009.

“Fraud-on-the-Market Theory: Is a Market Efficient?” (with Allen Michel and Israel Shaked) *American Bankruptcy Institute Journal*, May 2005.

“Valuation of Credit Guarantees,” (with Allen J. Michel and Israel Shaked) *Journal of Forensic Economics* 17(1), pp. 17-37, 2005.



**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

“A Better Understanding of why NPV Undervalues Managerial Flexibility,” (with Diane Lander) in *The Engineering Economist*, 2002, Volume 47, Number 4.

“Teaching the Strong-Form Efficient Market Hypothesis: A Classroom Experiment,” *Journal of Financial Education*, fall 2000.

*A Future for Real Estate Futures: Potential Applications of Derivatives in Real Estate Investment and Finance* (with Linda Stoller). Monograph. Boston: Real Estate Finance Association / Greater Boston Real Estate Board, May 2000.

“The Risk Budget: Using Your Human Resources,” (with John Marthinsen and John Edmunds) *Risk Management*, April 2000.

“Scenario Learning: A Powerful Tool for the 21<sup>st</sup> Century Planner,” (with Jeffrey Ellis and Dennis Stearns) *The Journal of Financial Planning*, April 2000.

“Protecting Future Product Liability Claimants in the Case of Bankruptcy,” (with Allen Michel and Israel Shaked) *American Bankruptcy Institute Journal*, January 2000.

“Measuring Risk with the Bodie Put When Stocks Exhibit Mean Reversion,” *The Journal of Risk*, Vol. 1, No. 3, 1999.

“Just-in-Time Mathematics: Integrating the Teaching of Finance Theory and Mathematics,” (with Gordon Prichett) *Primus*, Vol. IX, No. 2, June 1999.

*Atlanta Park Medical Center v. Hamlin Asset Management*. (with Natalie Taylor). Babson Case Collection, Harvard Business School Press, 1998.

“Dealing with Delta,” *Derivatives Week*, VII, No. 44, November 2, 1998.

“Expected Return in Option Pricing: A Non-Mathematical Explanation,” *Derivatives Week*, VII, No. 35, August 31, 1998.

“When Hedges Fail: The Put Paradox and its Solution,” *Derivatives Quarterly*, Vol. 4, No. 2, Winter 1997.

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

*Finance and Accounting for Project Management*. New York: American Management Association, 1996.

“International Investing,” in *Irwin’s Directory of Emerging Market Brokerages*. New York: Irwin, 1996.

“The Hull and White Implied Volatility,” Boston University Working Paper #92-51, 1992.

“Immunizing Against Interest Rate Risk Using the Macaulay Duration Statistic: An Assessment,” (with Don Smith) in *Financial Systems and Risk Management*, the proceedings of the US-Japan Forum on Financial Strategy in the 1990s, sponsored by Osaka Foundation of International Exchange and Boston University, August 1991.

“Covered Call Options: A Proposal to Ease LDC Debt,” (with Peter Abken) *Federal Reserve Bank of Atlanta Economic Review*, March/April 1990. Reprinted in *Financial Derivatives: New Instruments and Their Uses*. Atlanta: Federal Reserve Bank.

“Forecasting Stock-Market Volatility Using Options on Index Futures,” *Federal Reserve Bank of Atlanta Economic Review*, May/June 1989. Reprinted in *Financial Derivatives: New Instruments and Their Uses*. Atlanta: Federal Reserve Bank.

“The Black-Scholes Formula is Nearly Linear in Sigma for At-the-Money Options; Therefore Implied Volatilities from At-the-Money Options are Virtually Unbiased,” Federal Reserve Bank of Atlanta Working Paper #88-9, December 1988.

“The Effect of the ‘Triple Witching Hour’ on Stock Market Volatility,” (with William Goetzmann) *Federal Reserve Bank of Atlanta Economic Review*, September/October 1988. Reprinted in *Financial Derivatives: New Instruments and Their Uses*. Atlanta: Federal Reserve Bank.

“Stock Market Volatility,” *Federal Reserve Bank of Atlanta Economic Review*, November/December 1987.

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

Book review of *In Who's Interest: International Banking and American Foreign Policy*, by Benjamin J. Cohen, Yale University Press, in *Federal Reserve Bank of Atlanta Economic Review*, Summer 1987.

**PRESENTATIONS**

“Proving and Disproving Market Efficiency for Appraisal Hearings,” at the NACVA/CTI Business Valuation and Financial Litigation Super Conference, July 2023.

“SPAC Public Warrant Valuation Using Iterative Monte Carlo Simulation,” (with Ayussh Ahuja, Achraf Krafssi, and Dukalion Tsapalas) at the Financial Management Association Annual Meeting, October 2021.

“Stock Price Reactivity to Earnings Announcements: A Cross-Sectional Analysis of the *Cammer/Krogman* Factors,” (with Miguel Villanueva) at the Boston Area Finance Symposium, April 2018.

“Stock Price Reactivity to Earnings Announcements: A Cross-Sectional Analysis of the *Cammer/Krogman* Factors,” (with Miguel Villanueva) at the Eastern Finance Association Conference, April 2018.

“Determining the Defendant’s Ability to Pay,” at Taxpayers Against Fraud Education Fund Conference, October 2010.

“The Computation of Damages in Securities Fraud Cases,” at the Grant and Eisenhower Institutional Investor Conference, December 2002.

“The Role of the Financial Expert in Complex Litigation,” at the Financial Management Association Conference, October 2000.

“Entrepreneurial Incentives and Resource Allocation Among Corporate Venturing Initiatives,” (with Joel Shulman and U. Srinivasa Rangan), Babson Entrepreneurship Research Conference, May 2000.

“Application of Real Options in Purchasing Strategies,” (with Juan Orozco), presented at the International Applied Business Research Conference, March 2000.

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

“A Future for Real Estate Futures,” (with Linda Stoller) at the Fairfield County chapter of the Real Estate Finance Association, November 1999, and at the Greater Boston Real Estate Board, November 2000.

“Atlanta Park Medical Center v. Hamlin Asset Management,” (with Natalie Taylor) at the 1999 convention of the North American Case Research Association.

“Using Future Worlds™ in the Financial Planning Process,” (with Jeffrey Ellis) at the Institute of Certified Financial Planners Masters Retreat, October 1999.

“Toward a Better Understanding of Real Options: A Weighted Average Discount Rate Approach,” at the 1999 Financial Management Association Conference, the 1999 European Financial Management Association Conference, and the 1999 Multinational Finance Society Conference.

“Just-In-Time Mathematics: Integrating the Teaching of Finance Theory and Mathematics,” (with Gordon Prichett) at the 1999 Financial Management Association Conference.

“Alternative Dow Investments for the Individual Investor: Diamonds, Synthetics, and the Real Thing,” at the 1999 Academy of Financial Services Convention.

“Evidence of Yield Burning in Municipal Refundings,” at Financial Management Association Convention, October 1997; Government Finance Officers Association, 1997; and Northeast Regional Convention of the National Association of State Treasurers, 1997.

“Teaching the Strong-Form Efficient Market Hypothesis,” at Conference on Classroom Experiments in the Teaching of Economics at University of Virginia, September 1995.

“Efficient Consolidation of Implied Standard Deviations,” (with Shaikh Hamid) at Midwest Finance Association, March 1995.

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

“A Test of Intertemporal Averaging of Implied Volatilities,” (with Shaikh Hamid) at Eastern Finance Association, April 1995.

“Taking Advantage of Volatility: Non-linear Forecasting and Options Strategies,” (with Hassan Ahmed) at Chicago Board of Trade / Chicago Board Options Exchange Conference on Risk Management, February 1992.

“Immunizing Against Interest Rate Risk Using the Macaulay Duration Statistic: An Assessment,” (with Don Smith) at Japan-U.S. Conference on Financial Strategies in the 1990s, Osaka, Japan, August 1991.

“The Hull and White Implied Volatility,” at American Finance Association Convention, December 1990.

**REVIEWED ARTICLES AND BOOKS FOR:**

Harvard Business School Publishing  
Elsevier  
Journal of Economic Education  
Journal of Forensic Economics  
Journal of Risk  
Financial Review  
North American Case Research Association  
Financial Management  
Journal of Business  
Journal of Money, Credit and Banking  
Quarterly Review of Economics and Finance  
Blackwell  
Prentice Hall  
Southwestern Publishing

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

**COURSES TAUGHT**

Advanced Derivative Securities (MBA)  
Babson College Fund (Undergraduate and MBA)  
Capital Markets (MBA)  
Continuous-Time Finance (Doctoral)  
Corporate Finance (MBA and Executive)  
Corporate Financial Strategy (MBA)  
Cross-Functional Management (Integrated curriculum, Undergraduate)  
Equity Markets (MBA)  
Derivatives: Theory and Practice (MBA)  
Financial Reporting and Corporate Finance (MBA)  
Financial Management (MBA)  
Fixed Income Analysis (Undergraduate and MBA)  
Introduction to Derivative Securities (Executive)  
International Finance (Executive)  
Integrated Management (Undergraduate)  
Investments (MBA and Executive)  
Mod B: Decision Making and Applications, Finance stream (MBA)  
Options and Futures (Undergraduate)  
Risk Management (MBA)  
Portfolio Theory / Management Information Systems (Executive)  
Quantitative Methods for Investment Management (Undergraduate and MBA)  
Security Valuation (Undergraduate and MBA)

**TEACHING AWARDS**

Reid Teaching Award, Washington University, Olin School of Business, 1993-94.

**SELECT LIST OF MEDIA CITATIONS**

“Is Insider Trading Part of the Fabric?” by Gretchen Morgenson, *The New York Times*, May 19, 2012.

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

“Bankers Rigging Municipal Contract Bids Admit to Cover-Up Lies,” by William Selway and Martin Z. Braun, *Bloomberg Markets Magazine*, November 24, 2010.

“Hospital Move Presents Buy-Out Groups with New Risks,” by Francesco Guerra, Christopher Bowe, and Rebecca Knight, *Financial Times*, July 15, 2006.

“Funds of Knowledge Add Value,” by Rebecca Knight, *Financial Times*, March 12, 2006.

“City’s Financial Picture Worse Than Ever, Sanders Says,” by Matthew T. Hall, *San Diego Union-Tribune*, January 7, 2006.

“Downer: Stock Market Takes Another Dive,” by John Chesto, *Boston Herald*, July 23, 2002.

“Banks, Developers, Are Main Beneficiaries,” [editorial column] by Steven Feinstein, *The Boston Globe*, March 31, 2002, p. C4.

“Washington Investing: What Michael Saylor is Really Worth,” by Jerry Knight, *The Washington Post*, March 6, 2000.

“IBM Retools Pensions,” by Stephanie Armour, *USA Today*, May 4, 1999.

“L.A. MTA’s Law Firm Says Lissack Strategy Will be a Replay,” by Andrea Figler, *Bond Buyer*, September 30, 1998.

“Fed Key Player in Rescue of Floundering Hedge Fund,” by Andrew Fraser, Associated Press, September 25, 1998.

“Top Banks Plan Bailout for Fund,” by Andrew Fraser, Associated Press, September 24, 1998.

“Clarion Call to the Small Investor,” by Jo-Ann Johnston, *The Boston Globe*, March 4, 1998.

“L.A. Authority Study Shows Rampant Yield Burning Abuse,” by Michael

**Exhibit-2**  
**Curriculum Vitae**  
**Steven P. Feinstein, Ph.D., CFA**

Stanton, *The Bond Buyer*, April 22, 1997.

“Dispute Over Yield Burning Dominates GFOA Session,” by Michael Stanton, *The Bond Buyer*, January 29, 1997.

“Men Behaving Badly (Yield Burning),” *Grants Municipal Bond Observer*, January 24, 1997.

“Municipal Bond Dealers Face Scrutiny,” by Peter Truell, *The New York Times*, December 17, 1996.

“Iowa Market Takes Stock of Presidential Candidates,” by Stanley W. Angrist, *The Wall Street Journal*, August 28, 1995.

“Looking for Clues in Options Prices,” by Sylvia Nasar, *The New York Times*, July 18, 1991.

“For Fed, A New Set of Tea Leaves,” by Sylvia Nasar, *The New York Times*, July 5, 1991.

**MEMBERSHIP IN PROFESSIONAL SOCIETIES**

American Finance Association

CFA Society Boston

Chartered Financial Analyst Institute

Financial Management Association

Foundation for Advancement of Research in Financial Economics (founding member)

National Association of Forensic Economics

North American Case Research Association



**Exhibit-3**

**Steven P. Feinstein, Ph.D., CFA**  
**Testimony Provided in the Last Four Years**

In Re OvaScience, Inc. Securities Litigation  
Case No. 1:17-cv-10511-IT  
United States District Court  
District of Massachusetts  
Deposition Testimony  
December 2019

In Re Grupo Televisa Securities Litigation  
Civil Action No. 1:18-cv-01979-LLS  
United States District Court  
Southern District Of New York  
Deposition Testimony  
April 2020

In Re Blackberry Limited Securities Litigation  
Case No. 13-cv-07060-CM-KHP  
United States District Court  
Southern District Of New York  
Deposition Testimony  
July 2018  
Deposition Testimony  
July 2020

In Re Johnson & Johnson Securities Litigation  
Civil Action No. 3:18-cv-01833-FLW-TJB  
United States District Court  
District of New Jersey  
Deposition Testimony  
October 2020

In Re Envision Healthcare Corporation Securities Litigation  
Civil Action No. 3:17-cv-01112  
United States District Court  
Middle District of Tennessee  
Nashville Division  
Deposition Testimony  
January 2021

**Exhibit-3**

**Steven P. Feinstein, Ph.D., CFA**  
**Testimony Provided in the Last Four Years**

In Re Novo Nordisk Securities Litigation  
Civil Action No. 3:17-cv-209-BRM-LHG  
United States District Court  
District of New Jersey  
Deposition Testimony  
February 2021

In Re Jeld-Wen Holding, Inc. Securities Litigation  
Civil Action No. 3:20-cv-00112-JAG  
United States District Court  
Eastern District of Virginia  
Richmond Division  
Deposition Testimony  
January 2021  
Deposition Testimony  
February 2021

In Re Vale S.A. Securities Litigation  
Civil Action No. 19-cv-526-RJD-SJB  
United States District Court  
Eastern District of New York  
Deposition Testimony  
March 2021

In Re Endo International PLC Securities Litigation  
Case No. 2:17-cv-05114-MMB  
United States District Court  
Eastern District of Pennsylvania  
Deposition Testimony  
July 2021

In Re McKesson Corporation Securities Litigation  
Master File No. 3:18-cv-06525-CRB  
United States District Court  
Northern District of California  
Deposition Testimony  
August 2021

**Exhibit-3**

**Steven P. Feinstein, Ph.D., CFA**  
**Testimony Provided in the Last Four Years**

In Re Perrigo Company PLC Securities Litigation  
Master File No. 2:18-cv-02074  
United States District Court  
District of New Jersey  
Deposition Testimony  
October 2021

In Re Wells Fargo & Company Securities Litigation  
Master File No. 3:18-cv-03948-JD  
United States District Court  
Northern District of California  
Deposition Testimony  
November 2021

In Re Microchip Technology, Inc. Securities Litigation  
Case No. 2:18-cv-02914-JJT  
United States District Court  
District of Arizona  
Deposition Testimony  
October 2020  
Deposition Testimony  
January 2022

In Re Super Micro Computer, Inc. Securities Litigation  
Master File No. 4:18-cv-00838-JST  
United States District Court  
Northern District of California  
Deposition Testimony  
January 2022

In Re Cardinal Health, Inc. Securities Litigation  
Master File No. 2:19-cv-03347  
United States District Court  
Southern District of Ohio  
Eastern Division  
Deposition Testimony  
May 2022

**Exhibit-3**

**Steven P. Feinstein, Ph.D., CFA**  
**Testimony Provided in the Last Four Years**

In Re Gannett Co., Inc. ERISA Litigation  
Civil Action No. 1:18-cv-00325-AJT-JFA  
United States District Court  
Eastern District of Virginia  
Alexandria Division  
Deposition Testimony  
May 2022

In Re Apple Inc. Securities Litigation  
Case No. 4:19-cv-02033-YGR  
United States District Court  
Northern District of California  
Oakland Division  
Deposition Testimony  
June 2021  
Deposition Testimony  
July 2022

In Re Sealed Air Co., Securities Litigation  
Case No. 1:19-cv-10161-LLS  
United States District Court  
Southern District of New York  
Deposition Testimony  
July 2022

In Re Aegean Marine Petroleum Network, Inc. Securities Litigation  
Case No. 18 Civ. 4993 (NRB)  
United States District Court  
Southern District of New York  
Deposition Testimony  
November 2022

In Re Synchrony Financial Securities Litigation  
Case No. 3:18-cv-01818-VAB  
United States District Court  
District of Connecticut  
Deposition Testimony  
December 2022

**Exhibit-3**

**Steven P. Feinstein, Ph.D., CFA**  
**Testimony Provided in the Last Four Years**

In Re Cabot Oil & Gas Corporation Securities Litigation  
Case No. 4:21-cv-02045  
United States District Court  
Southern District of Texas  
Deposition Testimony  
June 2023

In Re EQT Corporation Securities Litigation  
Master File No. 2:19-cv-00754-MPK  
United States District Court  
Western District of Pennsylvania  
Deposition Testimony  
May 2021  
Deposition Testimony  
July 2021  
Deposition Testimony  
July 2023

In Re Mallinckrodt Public Limited Company Securities Litigation  
Civil Action No. 20-10100(AET)(TJB)  
United States District Court  
District of New Jersey  
Deposition Testimony  
July 2023

In re Acadia Pharmaceuticals Inc. Securities Litigation  
Case No. 3:21-cv-00762-WQH-MSB  
United States District Court  
Southern District of California  
Deposition Testimony  
October 2023

In re Kirkland Lake Gold Ltd. Securities Litigation  
Case No. 20-cv-04953  
United States District Court  
Southern District of New York  
Deposition Testimony  
March 2023  
Deposition Testimony  
October 2023

**Exhibit-3**

**Steven P. Feinstein, Ph.D., CFA**  
**Testimony Provided in the Last Four Years**

In re Vale S.A. Securities Litigation  
Case No. 19-cv-526-RJD-SJB  
United States District Court  
Eastern District of New York  
Deposition Testimony  
October 2023

In re Alta Mesa Resources, Inc.  
Case No. 4:19-cv-00957  
United States District Court  
Southern District of Texas  
Houston Division  
Deposition Testimony  
November 2023

In Re Ripple Labs Inc. Litigation  
Case No. 4:18-cv-06753-PJH  
United States District Court  
Northern District of California  
Deposition Testimony  
January 2023  
Deposition Testimony  
December 2023

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
6/15/2020	\$93.74	-	\$93.62	\$93.74	511,324	
6/16/2020	\$97.47	-	\$97.46	\$97.70	388,863	3.90%
6/17/2020	\$96.02	-	\$96.01	\$96.02	264,433	-1.50%
6/18/2020	\$96.51	-	\$96.41	\$96.52	231,283	0.51%
6/19/2020	\$94.59	-	\$94.59	\$94.75	537,109	-2.01%
6/22/2020	\$94.96	-	\$94.90	\$94.97	260,291	0.39%
6/23/2020	\$93.92	-	\$93.82	\$93.94	224,084	-1.10%
6/24/2020	\$92.15	-	\$92.14	\$92.31	420,726	-1.90%
6/25/2020	\$95.76	-	\$95.70	\$95.95	621,113	3.84%
6/26/2020	\$97.97	-	\$97.99	\$98.00	708,664	2.28%
6/29/2020	\$97.56	-	\$97.47	\$97.59	335,828	-0.42%
6/30/2020	\$101.17	\$0.03	\$101.06	\$101.18	411,904	3.66%
7/1/2020	\$102.34	-	\$102.27	\$102.34	449,979	1.15%
7/2/2020	\$103.00	-	\$103.00	\$103.19	222,284	0.64%
7/6/2020	\$102.50	-	\$102.44	\$102.50	450,925	-0.49%
7/7/2020	\$99.69	-	\$99.69	\$99.70	419,784	-2.78%
7/8/2020	\$101.34	-	\$101.30	\$101.34	284,347	1.64%
7/9/2020	\$101.28	-	\$101.29	\$101.41	266,972	-0.06%
7/10/2020	\$100.16	-	\$100.15	\$100.16	318,572	-1.11%
7/13/2020	\$99.33	-	\$99.33	\$99.48	697,619	-0.83%
7/14/2020	\$98.45	-	\$98.28	\$98.46	254,986	-0.89%
7/15/2020	\$98.72	-	\$98.65	\$98.72	278,652	0.27%
7/16/2020	\$98.16	-	\$98.07	\$98.16	163,851	-0.57%
7/17/2020	\$100.51	-	\$100.54	\$100.66	266,711	2.37%
7/20/2020	\$104.19	-	\$104.18	\$104.30	263,211	3.60%
7/21/2020	\$104.26	-	\$104.24	\$104.28	441,535	0.07%
7/22/2020	\$105.46	-	\$105.49	\$105.60	203,134	1.14%
7/23/2020	\$103.73	-	\$103.72	\$103.88	194,893	-1.65%
7/24/2020	\$101.92	-	\$101.92	\$102.03	281,056	-1.76%
7/27/2020	\$104.45	-	\$104.45	\$104.56	267,360	2.45%
7/28/2020	\$104.36	-	\$104.36	\$104.56	342,430	-0.09%
7/29/2020	\$114.59	-	\$114.59	\$114.73	610,413	9.35%
7/30/2020	\$114.98	-	\$114.76	\$114.99	316,161	0.34%
7/31/2020	\$116.89	-	\$116.88	\$117.00	346,534	1.65%
8/3/2020	\$118.32	-	\$118.15	\$118.35	303,864	1.22%
8/4/2020	\$116.48	-	\$116.47	\$116.57	357,896	-1.57%
8/5/2020	\$116.14	-	\$116.14	\$116.25	439,089	-0.29%
8/6/2020	\$116.30	-	\$116.29	\$116.59	300,005	0.14%
8/7/2020	\$114.66	-	\$114.42	\$114.71	307,062	-1.42%
8/10/2020	\$113.60	-	\$113.60	\$113.67	309,999	-0.93%
8/11/2020	\$114.50	-	\$114.40	\$114.46	602,116	0.79%
8/12/2020	\$115.00	-	\$114.86	\$114.99	319,776	0.44%
8/13/2020	\$116.81	-	\$116.80	\$116.96	250,454	1.56%
8/14/2020	\$116.03	-	\$116.02	\$116.35	183,642	-0.67%
8/17/2020	\$117.47	-	\$117.31	\$117.51	171,982	1.23%
8/18/2020	\$117.94	-	\$117.91	\$117.94	185,459	0.40%
8/19/2020	\$118.76	-	\$118.75	\$118.87	160,390	0.69%
8/20/2020	\$119.82	-	\$119.81	\$119.85	192,817	0.89%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
8/21/2020	\$119.87	-	\$119.69	\$119.87	372,187	0.04%
8/24/2020	\$122.13	-	\$122.13	\$122.33	312,196	1.87%
8/25/2020	\$124.28	-	\$124.41	\$124.45	316,221	1.75%
8/26/2020	\$129.95	-	\$129.80	\$130.01	546,428	4.46%
8/27/2020	\$127.90	-	\$127.79	\$127.90	309,138	-1.59%
8/28/2020	\$128.97	-	\$128.85	\$128.97	253,015	0.83%
8/31/2020	\$128.47	-	\$128.31	\$128.45	224,738	-0.39%
9/1/2020	\$132.72	-	\$132.56	\$132.74	319,153	3.25%
9/2/2020	\$134.82	-	\$134.71	\$134.82	222,348	1.57%
9/3/2020	\$127.94	-	\$127.94	\$128.20	306,800	-5.24%
9/4/2020	\$124.26	-	\$124.15	\$124.34	314,353	-2.92%
9/8/2020	\$120.01	-	\$119.90	\$120.14	363,726	-3.48%
9/9/2020	\$125.16	-	\$124.89	\$125.20	288,777	4.20%
9/10/2020	\$122.38	-	\$122.14	\$122.39	210,563	-2.25%
9/11/2020	\$119.66	-	\$119.67	\$119.91	206,674	-2.25%
9/14/2020	\$121.32	-	\$121.32	\$121.33	241,763	1.38%
9/15/2020	\$123.39	-	\$123.20	\$123.42	186,417	1.69%
9/16/2020	\$121.42	-	\$121.39	\$121.42	261,387	-1.61%
9/17/2020	\$119.52	-	\$119.52	\$119.72	245,012	-1.58%
9/18/2020	\$118.57	-	\$118.56	\$118.74	471,449	-0.80%
9/21/2020	\$120.09	-	\$120.08	\$120.26	207,208	1.27%
9/22/2020	\$120.75	-	\$120.57	\$120.76	231,098	0.55%
9/23/2020	\$116.13	-	\$115.71	\$116.20	279,155	-3.90%
9/24/2020	\$115.99	-	\$115.91	\$115.99	248,969	-0.12%
9/25/2020	\$118.86	-	\$118.63	\$118.91	215,005	2.44%
9/28/2020	\$120.28	-	\$120.18	\$120.28	179,654	1.19%
9/29/2020	\$121.66	-	\$121.56	\$121.81	262,979	1.14%
9/30/2020	\$121.04	\$0.03	\$121.04	\$121.23	295,483	-0.49%
10/1/2020	\$123.97	-	\$123.94	\$124.19	219,078	2.39%
10/2/2020	\$121.78	-	\$121.53	\$121.78	181,225	-1.78%
10/5/2020	\$125.46	-	\$125.46	\$125.51	328,861	2.98%
10/6/2020	\$128.26	-	\$128.26	\$128.52	539,860	2.21%
10/7/2020	\$130.11	-	\$130.10	\$130.25	217,005	1.43%
10/8/2020	\$128.90	-	\$128.90	\$129.00	205,487	-0.93%
10/9/2020	\$131.36	-	\$131.36	\$131.74	226,307	1.89%
10/12/2020	\$132.73	-	\$132.65	\$133.03	174,278	1.04%
10/13/2020	\$132.40	-	\$132.15	\$132.41	233,265	-0.25%
10/14/2020	\$131.49	-	\$131.48	\$131.68	199,604	-0.69%
10/15/2020	\$130.05	-	\$129.99	\$130.11	192,789	-1.10%
10/16/2020	\$130.74	-	\$130.74	\$130.98	113,427	0.53%
10/19/2020	\$129.21	-	\$128.95	\$129.21	169,133	-1.18%
10/20/2020	\$129.27	-	\$129.23	\$129.27	275,733	0.05%
10/21/2020	\$129.91	-	\$129.69	\$129.88	189,231	0.49%
10/22/2020	\$132.00	-	\$131.79	\$132.13	221,586	1.60%
10/23/2020	\$134.23	-	\$134.07	\$134.23	368,029	1.68%
10/26/2020	\$129.38	-	\$129.37	\$129.52	341,644	-3.68%
10/27/2020	\$123.91	-	\$123.91	\$124.04	387,065	-4.32%



**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
10/28/2020	\$120.27	-	\$120.25	\$120.42	437,413	-2.98%
10/29/2020	\$118.70	-	\$118.70	\$118.71	756,102	-1.31%
10/30/2020	\$115.88	-	\$115.88	\$116.07	475,923	-2.40%
11/2/2020	\$113.40	-	\$113.39	\$113.50	255,424	-2.16%
11/3/2020	\$116.01	-	\$115.69	\$116.02	314,565	2.28%
11/4/2020	\$121.22	-	\$121.10	\$121.22	235,566	4.39%
11/5/2020	\$123.69	-	\$123.67	\$123.69	217,921	2.02%
11/6/2020	\$126.60	-	\$126.47	\$126.60	212,709	2.33%
11/9/2020	\$124.31	-	\$124.31	\$124.60	193,214	-1.83%
11/10/2020	\$121.31	-	\$121.38	\$121.53	301,830	-2.44%
11/11/2020	\$123.34	-	\$123.34	\$123.48	148,173	1.66%
11/12/2020	\$119.39	-	\$119.38	\$119.67	373,711	-3.25%
11/13/2020	\$120.86	-	\$120.81	\$120.86	158,260	1.22%
11/16/2020	\$121.82	-	\$121.70	\$121.81	272,764	0.79%
11/17/2020	\$123.80	-	\$123.71	\$123.81	313,642	1.61%
11/18/2020	\$122.50	-	\$122.50	\$122.59	182,121	-1.06%
11/19/2020	\$127.07	-	\$126.81	\$127.08	225,854	3.66%
11/20/2020	\$129.39	-	\$129.13	\$129.39	239,398	1.81%
11/23/2020	\$129.52	-	\$129.28	\$129.62	168,065	0.10%
11/24/2020	\$128.29	-	\$128.15	\$128.30	123,874	-0.95%
11/25/2020	\$130.49	-	\$130.24	\$130.49	165,262	1.70%
11/27/2020	\$132.21	-	\$132.09	\$132.21	83,892	1.31%
11/30/2020	\$130.88	-	\$130.68	\$130.87	195,439	-1.01%
12/1/2020	\$129.97	-	\$129.79	\$130.07	202,247	-0.70%
12/2/2020	\$127.80	-	\$127.72	\$127.80	158,218	-1.68%
12/3/2020	\$129.74	-	\$129.74	\$129.87	159,678	1.51%
12/4/2020	\$130.78	-	\$130.78	\$131.12	303,334	0.80%
12/7/2020	\$128.06	-	\$128.05	\$128.25	307,231	-2.10%
12/8/2020	\$125.34	-	\$125.34	\$125.55	271,045	-2.15%
12/9/2020	\$124.96	-	\$124.95	\$124.96	303,276	-0.30%
12/10/2020	\$124.08	-	\$123.93	\$124.08	270,608	-0.71%
12/11/2020	\$125.23	-	\$125.23	\$125.51	112,678	0.92%
12/14/2020	\$125.42	-	\$125.18	\$125.42	194,408	0.15%
12/15/2020	\$125.57	-	\$125.54	\$125.68	226,866	0.12%
12/16/2020	\$126.83	-	\$126.61	\$126.83	254,312	1.00%
12/17/2020	\$132.98	-	\$132.87	\$133.08	469,687	4.74%
12/18/2020	\$133.38	-	\$133.16	\$133.58	352,461	0.30%
12/21/2020	\$133.84	-	\$133.84	\$134.08	174,012	0.34%
12/22/2020	\$137.07	-	\$137.04	\$137.32	235,114	2.38%
12/23/2020	\$139.82	-	\$139.66	\$139.81	395,816	1.99%
12/24/2020	\$138.63	-	\$138.18	\$138.63	71,682	-0.85%
12/28/2020	\$133.30	-	\$133.13	\$133.30	254,989	-3.92%
12/29/2020	\$130.65	-	\$130.47	\$130.65	179,154	-2.01%
12/30/2020	\$131.67	\$0.03	\$131.67	\$131.87	141,288	0.80%
12/31/2020	\$133.26	-	\$133.02	\$133.26	206,437	1.20%
1/4/2021	\$131.67	-	\$131.51	\$131.69	220,798	-1.20%
1/5/2021	\$134.02	-	\$134.02	\$134.26	269,851	1.77%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
1/6/2021	\$131.89	-	\$131.89	\$132.05	395,276	-1.60%
1/7/2021	\$136.23	-	\$135.96	\$136.23	210,184	3.24%
1/8/2021	\$136.11	-	\$136.11	\$136.33	157,950	-0.09%
1/11/2021	\$135.00	-	\$134.77	\$135.17	139,931	-0.82%
1/12/2021	\$132.50	-	\$132.45	\$132.75	146,022	-1.87%
1/13/2021	\$131.83	-	\$131.73	\$132.02	297,336	-0.51%
1/14/2021	\$133.50	-	\$133.50	\$133.54	371,862	1.26%
1/15/2021	\$134.17	-	\$134.10	\$134.17	741,845	0.50%
1/19/2021	\$137.96	-	\$137.79	\$137.97	400,462	2.79%
1/20/2021	\$142.68	-	\$142.62	\$142.74	382,946	3.36%
1/21/2021	\$142.60	-	\$142.52	\$142.60	433,772	-0.06%
1/22/2021	\$143.34	-	\$143.34	\$143.52	320,020	0.52%
1/25/2021	\$137.25	-	\$137.24	\$137.33	671,116	-4.34%
1/26/2021	\$136.24	-	\$136.24	\$136.26	265,048	-0.74%
1/27/2021	\$133.48	-	\$133.31	\$133.48	684,073	-2.05%
1/28/2021	\$131.66	-	\$131.52	\$131.67	372,955	-1.37%
1/29/2021	\$127.45	-	\$127.39	\$127.65	311,625	-3.25%
2/1/2021	\$129.07	-	\$129.07	\$129.33	263,985	1.26%
2/2/2021	\$134.88	-	\$134.88	\$134.98	617,273	4.40%
2/3/2021	\$134.68	-	\$134.68	\$134.84	232,446	-0.15%
2/4/2021	\$138.37	-	\$138.34	\$138.60	277,425	2.70%
2/5/2021	\$139.98	-	\$139.72	\$139.98	372,214	1.16%
2/8/2021	\$142.79	-	\$142.79	\$142.80	827,907	1.99%
2/9/2021	\$144.00	-	\$143.84	\$144.00	297,283	0.84%
2/10/2021	\$142.54	-	\$142.14	\$142.54	187,813	-1.02%
2/11/2021	\$146.01	-	\$146.01	\$146.21	168,133	2.41%
2/12/2021	\$146.71	-	\$146.66	\$146.91	158,553	0.48%
2/16/2021	\$146.01	-	\$145.62	\$146.02	270,111	-0.48%
2/17/2021	\$141.74	-	\$141.74	\$141.92	378,779	-2.97%
2/18/2021	\$143.11	-	\$142.68	\$143.21	612,379	0.96%
2/19/2021	\$146.21	-	\$146.21	\$146.30	364,561	2.14%
2/22/2021	\$146.55	-	\$146.09	\$146.62	671,990	0.23%
2/23/2021	\$140.98	-	\$140.98	\$141.06	355,891	-3.87%
2/24/2021	\$139.31	-	\$139.31	\$139.50	325,769	-1.19%
2/25/2021	\$130.71	-	\$130.42	\$130.71	333,695	-6.37%
2/26/2021	\$132.35	-	\$132.06	\$132.35	220,009	1.25%
3/1/2021	\$136.08	-	\$136.08	\$136.29	172,966	2.78%
3/2/2021	\$130.45	-	\$130.33	\$130.45	239,211	-4.23%
3/3/2021	\$124.00	-	\$124.00	\$124.25	449,406	-5.07%
3/4/2021	\$118.46	-	\$118.45	\$118.63	615,290	-4.57%
3/5/2021	\$121.08	-	\$121.13	\$121.14	543,988	2.19%
3/8/2021	\$114.72	-	\$114.64	\$114.65	942,314	-5.40%
3/9/2021	\$119.00	-	\$119.00	\$119.04	713,223	3.66%
3/10/2021	\$119.99	-	\$119.95	\$120.00	474,072	0.83%
3/11/2021	\$124.19	-	\$124.16	\$124.41	349,414	3.44%
3/12/2021	\$123.40	-	\$123.40	\$123.44	389,610	-0.64%
3/15/2021	\$122.63	-	\$122.31	\$122.63	313,221	-0.63%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
3/16/2021	\$121.76	-	\$121.36	\$121.83	209,570	-0.71%
3/17/2021	\$120.10	-	\$119.87	\$120.10	397,927	-1.37%
3/18/2021	\$112.38	-	\$112.38	\$112.47	550,538	-6.64%
3/19/2021	\$116.49	-	\$116.07	\$116.49	507,780	3.59%
3/22/2021	\$117.76	-	\$117.75	\$117.96	252,775	1.08%
3/23/2021	\$115.74	-	\$115.62	\$115.75	231,596	-1.73%
3/24/2021	\$113.49	-	\$113.30	\$113.49	304,505	-1.96%
3/25/2021	\$113.01	-	\$113.00	\$113.01	523,621	-0.42%
3/26/2021	\$116.76	-	\$116.72	\$116.90	371,452	3.26%
3/29/2021	\$112.53	-	\$112.45	\$112.83	232,814	-3.69%
3/30/2021	\$112.55	-	\$112.40	\$112.74	284,188	0.02%
3/31/2021	\$114.34	\$0.03	\$114.34	\$114.35	354,892	1.60%
4/1/2021	\$117.99	-	\$117.78	\$117.99	261,066	3.14%
4/5/2021	\$117.91	-	\$117.88	\$117.91	386,788	-0.07%
4/6/2021	\$120.04	-	\$119.97	\$120.27	609,966	1.79%
4/7/2021	\$118.26	-	\$118.05	\$118.27	466,895	-1.49%
4/8/2021	\$120.62	-	\$120.52	\$120.69	708,025	1.98%
4/9/2021	\$123.52	-	\$123.52	\$123.65	308,446	2.38%
4/12/2021	\$124.65	-	\$124.65	\$124.67	242,397	0.91%
4/13/2021	\$128.78	-	\$128.76	\$128.89	386,782	3.26%
4/14/2021	\$127.86	-	\$127.87	\$128.08	210,724	-0.72%
4/15/2021	\$131.71	-	\$131.72	\$131.87	266,318	2.97%
4/16/2021	\$129.89	-	\$129.88	\$130.00	189,931	-1.39%
4/19/2021	\$128.59	-	\$128.59	\$128.63	344,984	-1.01%
4/20/2021	\$126.77	-	\$126.59	\$126.77	287,313	-1.43%
4/21/2021	\$127.73	-	\$127.72	\$127.98	134,102	0.75%
4/22/2021	\$129.33	-	\$129.33	\$129.63	163,467	1.24%
4/23/2021	\$130.79	-	\$130.79	\$130.87	216,043	1.12%
4/26/2021	\$131.01	-	\$131.01	\$131.07	225,625	0.17%
4/27/2021	\$129.30	-	\$129.42	\$129.43	1,057,462	-1.31%
4/28/2021	\$128.67	-	\$128.60	\$129.01	574,382	-0.49%
4/29/2021	\$126.97	-	\$126.70	\$127.00	394,926	-1.33%
4/30/2021	\$126.94	-	\$126.79	\$126.94	328,964	-0.02%
5/3/2021	\$124.06	-	\$123.90	\$124.06	244,823	-2.29%
5/4/2021	\$121.29	-	\$121.28	\$121.45	336,440	-2.26%
5/5/2021	\$118.06	-	\$118.05	\$118.32	313,776	-2.70%
5/6/2021	\$118.44	-	\$118.32	\$118.50	222,689	0.32%
5/7/2021	\$120.22	-	\$120.22	\$120.35	195,047	1.49%
5/10/2021	\$118.40	-	\$118.20	\$118.40	157,358	-1.53%
5/11/2021	\$120.03	-	\$119.81	\$120.08	169,842	1.37%
5/12/2021	\$116.64	-	\$116.64	\$116.87	230,882	-2.86%
5/13/2021	\$118.28	-	\$118.15	\$118.28	496,186	1.40%
5/14/2021	\$120.35	-	\$120.35	\$120.50	123,725	1.73%
5/17/2021	\$116.77	-	\$116.77	\$116.91	282,854	-3.02%
5/18/2021	\$118.52	-	\$118.52	\$118.65	157,376	1.49%
5/19/2021	\$117.86	-	\$117.54	\$117.86	235,644	-0.56%
5/20/2021	\$120.73	-	\$120.61	\$120.76	175,063	2.41%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
5/21/2021	\$120.91	-	\$120.89	\$121.03	151,491	0.15%
5/24/2021	\$122.02	-	\$121.77	\$122.01	153,153	0.91%
5/25/2021	\$121.65	-	\$121.50	\$121.65	236,945	-0.30%
5/26/2021	\$120.68	-	\$120.65	\$120.68	1,001,887	-0.80%
5/27/2021	\$120.24	-	\$120.05	\$120.24	229,734	-0.37%
5/28/2021	\$118.14	-	\$118.06	\$118.10	355,299	-1.76%
6/1/2021	\$118.00	-	\$117.78	\$118.00	238,952	-0.12%
6/2/2021	\$117.68	-	\$117.63	\$117.82	234,592	-0.27%
6/3/2021	\$116.02	-	\$115.77	\$116.02	332,808	-1.42%
6/4/2021	\$119.85	-	\$119.81	\$119.85	272,645	3.25%
6/7/2021	\$123.92	-	\$123.91	\$124.05	309,595	3.34%
6/8/2021	\$127.92	-	\$127.91	\$128.00	738,152	3.18%
6/9/2021	\$127.27	-	\$127.28	\$127.48	425,693	-0.51%
6/10/2021	\$128.56	-	\$128.43	\$128.57	295,580	1.01%
6/11/2021	\$131.29	-	\$131.23	\$131.29	352,316	2.10%
6/14/2021	\$134.96	-	\$134.97	\$134.98	582,812	2.76%
6/15/2021	\$133.54	-	\$133.52	\$133.54	336,359	-1.06%
6/16/2021	\$132.84	-	\$132.80	\$132.94	449,404	-0.53%
6/17/2021	\$136.44	-	\$136.33	\$136.44	191,753	2.67%
6/18/2021	\$137.15	-	\$136.79	\$137.16	1,262,020	0.52%
6/21/2021	\$137.58	-	\$137.42	\$137.58	185,231	0.31%
6/22/2021	\$138.35	-	\$138.26	\$138.41	139,345	0.56%
6/23/2021	\$139.40	-	\$139.40	\$139.46	117,334	0.76%
6/24/2021	\$139.54	-	\$139.37	\$139.55	181,373	0.10%
6/25/2021	\$140.37	-	\$140.26	\$140.37	415,264	0.59%
6/28/2021	\$140.65	-	\$140.65	\$140.91	174,986	0.20%
6/29/2021	\$141.92	-	\$141.91	\$142.17	204,502	0.90%
6/30/2021	\$139.19	\$0.03	\$139.15	\$139.40	144,553	-1.92%
7/1/2021	\$138.33	-	\$138.15	\$138.33	294,156	-0.62%
7/2/2021	\$139.97	-	\$139.85	\$140.00	202,273	1.18%
7/6/2021	\$140.06	-	\$139.94	\$140.13	405,931	0.06%
7/7/2021	\$138.78	-	\$138.52	\$138.78	159,462	-0.92%
7/8/2021	\$137.53	-	\$137.43	\$137.53	249,723	-0.90%
7/9/2021	\$137.52	-	\$137.45	\$137.53	237,638	-0.01%
7/12/2021	\$136.25	-	\$136.23	\$136.26	217,198	-0.93%
7/13/2021	\$135.66	-	\$135.66	\$135.79	180,021	-0.43%
7/14/2021	\$133.20	-	\$133.19	\$133.47	336,235	-1.83%
7/15/2021	\$131.38	-	\$131.38	\$131.59	154,179	-1.38%
7/16/2021	\$132.47	-	\$132.27	\$132.48	138,194	0.83%
7/19/2021	\$131.83	-	\$131.80	\$131.95	161,682	-0.48%
7/20/2021	\$135.08	-	\$135.08	\$135.18	244,244	2.44%
7/21/2021	\$135.97	-	\$135.97	\$136.09	96,703	0.66%
7/22/2021	\$136.00	-	\$135.90	\$136.06	192,077	0.02%
7/23/2021	\$136.80	-	\$136.80	\$136.93	104,093	0.59%
7/26/2021	\$136.64	-	\$136.65	\$136.78	77,789	-0.12%
7/27/2021	\$133.99	-	\$133.94	\$134.15	497,628	-1.96%
7/28/2021	\$136.89	-	\$136.67	\$136.94	194,479	2.14%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
7/29/2021	\$127.35	-	\$127.35	\$127.53	395,809	-7.22%
7/30/2021	\$127.64	-	\$127.41	\$127.64	395,734	0.23%
8/2/2021	\$127.01	-	\$126.93	\$127.01	221,764	-0.49%
8/3/2021	\$126.99	-	\$126.99	\$127.15	225,360	-0.02%
8/4/2021	\$126.75	-	\$126.58	\$126.80	172,027	-0.19%
8/5/2021	\$127.50	-	\$127.33	\$127.50	130,695	0.59%
8/6/2021	\$128.60	-	\$128.60	\$128.68	224,570	0.86%
8/9/2021	\$128.86	-	\$128.79	\$128.87	118,984	0.20%
8/10/2021	\$127.26	-	\$127.26	\$127.40	141,853	-1.25%
8/11/2021	\$126.48	-	\$126.48	\$126.60	116,239	-0.61%
8/12/2021	\$126.54	-	\$126.47	\$126.54	97,585	0.05%
8/13/2021	\$127.31	-	\$127.30	\$127.48	72,420	0.61%
8/16/2021	\$127.50	-	\$127.50	\$127.60	141,292	0.15%
8/17/2021	\$129.42	-	\$129.42	\$129.51	306,546	1.49%
8/18/2021	\$130.52	-	\$130.50	\$130.61	252,992	0.85%
8/19/2021	\$129.71	-	\$129.57	\$129.73	155,951	-0.62%
8/20/2021	\$131.54	-	\$131.54	\$131.64	154,568	1.40%
8/23/2021	\$132.51	-	\$132.38	\$132.52	186,498	0.73%
8/24/2021	\$133.24	-	\$133.23	\$133.55	98,770	0.55%
8/25/2021	\$133.93	-	\$133.94	\$134.11	160,180	0.52%
8/26/2021	\$134.57	-	\$134.56	\$134.63	155,384	0.48%
8/27/2021	\$138.00	-	\$138.00	\$138.08	159,862	2.52%
8/30/2021	\$138.39	-	\$138.24	\$138.39	147,222	0.28%
8/31/2021	\$137.63	-	\$137.63	\$137.70	175,636	-0.55%
9/1/2021	\$141.10	-	\$140.92	\$141.10	183,573	2.49%
9/2/2021	\$141.01	-	\$141.01	\$141.21	151,565	-0.06%
9/3/2021	\$142.39	-	\$142.35	\$142.46	141,072	0.97%
9/7/2021	\$139.84	-	\$139.74	\$139.84	189,416	-1.81%
9/8/2021	\$137.59	-	\$137.47	\$137.63	251,296	-1.62%
9/9/2021	\$136.65	-	\$136.65	\$136.68	429,914	-0.69%
9/10/2021	\$133.31	-	\$133.31	\$133.51	103,180	-2.47%
9/13/2021	\$132.47	-	\$132.47	\$132.61	124,734	-0.63%
9/14/2021	\$130.17	-	\$130.02	\$130.21	160,550	-1.75%
9/15/2021	\$132.26	-	\$132.26	\$132.47	155,417	1.59%
9/16/2021	\$131.96	-	\$131.96	\$132.11	183,415	-0.23%
9/17/2021	\$131.93	-	\$131.90	\$131.99	646,465	-0.02%
9/20/2021	\$129.44	-	\$129.33	\$129.51	224,387	-1.91%
9/21/2021	\$129.94	-	\$129.94	\$130.08	187,998	0.39%
9/22/2021	\$132.90	-	\$132.89	\$132.98	199,369	2.25%
9/23/2021	\$134.95	-	\$134.84	\$135.01	127,310	1.53%
9/24/2021	\$132.73	-	\$132.73	\$132.91	150,481	-1.66%
9/27/2021	\$132.35	-	\$132.35	\$132.44	177,970	-0.29%
9/28/2021	\$129.18	-	\$129.20	\$129.30	228,277	-2.42%
9/29/2021	\$127.58	-	\$127.59	\$127.66	158,605	-1.25%
9/30/2021	\$127.10	\$0.03	\$126.92	\$127.10	247,450	-0.35%
10/1/2021	\$128.61	-	\$128.61	\$128.72	273,475	1.18%
10/4/2021	\$123.00	-	\$123.00	\$123.23	304,582	-4.46%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
10/5/2021	\$124.56	-	\$124.56	\$124.68	376,057	1.26%
10/6/2021	\$124.63	-	\$124.63	\$124.79	138,183	0.06%
10/7/2021	\$126.45	-	\$126.28	\$126.47	141,366	1.45%
10/8/2021	\$124.46	-	\$124.46	\$124.62	73,029	-1.59%
10/11/2021	\$122.34	-	\$122.34	\$122.54	81,746	-1.72%
10/12/2021	\$124.09	-	\$123.93	\$124.09	78,585	1.42%
10/13/2021	\$126.05	-	\$126.01	\$126.19	97,950	1.57%
10/14/2021	\$130.47	-	\$130.44	\$130.47	242,040	3.45%
10/15/2021	\$129.37	-	\$129.24	\$129.37	141,517	-0.85%
10/18/2021	\$129.14	-	\$129.08	\$129.14	131,245	-0.18%
10/19/2021	\$130.71	-	\$130.50	\$130.71	72,933	1.21%
10/20/2021	\$130.51	-	\$130.51	\$130.80	72,657	-0.15%
10/21/2021	\$130.63	-	\$130.63	\$130.78	80,824	0.09%
10/22/2021	\$128.61	-	\$128.53	\$128.68	108,615	-1.56%
10/25/2021	\$128.07	-	\$128.07	\$128.20	134,644	-0.42%
10/26/2021	\$127.93	-	\$127.93	\$128.11	233,565	-0.11%
10/27/2021	\$124.46	-	\$124.46	\$124.77	365,548	-2.75%
10/28/2021	\$118.31	-	\$118.31	\$118.56	455,025	-5.07%
10/29/2021	\$118.72	-	\$118.71	\$118.73	485,775	0.35%
11/1/2021	\$119.80	-	\$119.75	\$119.89	441,180	0.91%
11/2/2021	\$122.58	-	\$122.54	\$122.64	319,746	2.29%
11/3/2021	\$121.80	-	\$121.69	\$121.80	363,377	-0.64%
11/4/2021	\$120.61	-	\$120.49	\$120.61	342,442	-0.98%
11/5/2021	\$120.11	-	\$120.07	\$120.17	253,768	-0.42%
11/8/2021	\$120.46	-	\$120.38	\$120.57	588,667	0.29%
11/9/2021	\$121.09	-	\$121.09	\$121.23	132,219	0.52%
11/10/2021	\$117.12	-	\$117.01	\$117.12	264,659	-3.33%
11/11/2021	\$117.41	-	\$117.41	\$117.53	313,500	0.25%
11/12/2021	\$118.77	-	\$118.77	\$118.86	99,888	1.15%
11/15/2021	\$118.45	-	\$118.29	\$118.45	79,291	-0.27%
11/16/2021	\$120.54	-	\$120.52	\$120.54	126,241	1.75%
11/17/2021	\$117.33	-	\$117.33	\$117.41	270,139	-2.70%
11/18/2021	\$118.00	-	\$118.02	\$118.05	301,336	0.57%
11/19/2021	\$119.94	-	\$119.90	\$120.02	283,571	1.63%
11/22/2021	\$119.34	-	\$119.33	\$119.39	519,091	-0.50%
11/23/2021	\$117.04	-	\$116.92	\$117.04	470,554	-1.95%
11/24/2021	\$117.61	-	\$117.60	\$117.72	240,019	0.49%
11/26/2021	\$114.85	-	\$114.84	\$115.13	90,892	-2.37%
11/29/2021	\$117.24	-	\$117.23	\$117.33	144,450	2.06%
11/30/2021	\$114.82	-	\$114.67	\$114.82	318,707	-2.09%
12/1/2021	\$109.36	-	\$109.35	\$109.46	230,413	-4.87%
12/2/2021	\$110.74	-	\$110.74	\$110.95	347,605	1.25%
12/3/2021	\$109.49	-	\$109.17	\$109.49	248,024	-1.14%
12/6/2021	\$110.58	-	\$110.38	\$110.58	440,959	0.99%
12/7/2021	\$112.94	-	\$112.89	\$113.00	201,155	2.11%
12/8/2021	\$115.33	-	\$115.23	\$115.35	160,354	2.09%
12/9/2021	\$112.98	-	\$112.81	\$112.99	118,443	-2.06%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
12/10/2021	\$113.40	-	\$113.40	\$113.53	146,486	0.37%
12/13/2021	\$115.87	-	\$115.82	\$115.94	269,680	2.15%
12/14/2021	\$111.73	-	\$111.59	\$111.73	399,131	-3.64%
12/15/2021	\$108.49	-	\$108.31	\$108.50	564,709	-2.94%
12/16/2021	\$104.20	-	\$104.20	\$104.44	468,487	-4.03%
12/17/2021	\$105.10	-	\$105.10	\$105.11	1,047,778	0.86%
12/20/2021	\$101.24	-	\$101.23	\$101.24	387,599	-3.74%
12/21/2021	\$108.04	-	\$107.92	\$108.04	504,941	6.50%
12/22/2021	\$109.45	-	\$109.31	\$109.45	444,016	1.30%
12/23/2021	\$110.46	-	\$110.46	\$110.62	179,014	0.92%
12/27/2021	\$112.69	-	\$112.62	\$112.81	247,008	2.00%
12/28/2021	\$111.95	-	\$111.83	\$111.95	239,083	-0.66%
12/29/2021	\$112.96	-	\$112.96	\$113.03	242,290	0.90%
12/30/2021	\$113.79	-	\$113.79	\$113.95	297,368	0.73%
12/31/2021	\$111.82	\$0.03	\$111.82	\$111.92	303,239	-1.72%
1/3/2022	\$110.25	-	\$110.25	\$110.42	362,125	-1.41%
1/4/2022	\$109.42	-	\$109.42	\$109.50	251,615	-0.76%
1/5/2022	\$97.26	-	\$97.17	\$97.27	976,171	-11.78%
1/6/2022	\$99.95	-	\$99.94	\$100.10	402,909	2.73%
1/7/2022	\$99.21	-	\$99.19	\$99.31	460,400	-0.74%
1/10/2022	\$98.69	-	\$98.69	\$98.97	266,448	-0.53%
1/11/2022	\$104.07	-	\$103.94	\$104.07	390,991	5.31%
1/12/2022	\$103.04	-	\$103.04	\$103.20	249,720	-0.99%
1/13/2022	\$99.02	-	\$99.01	\$99.26	316,093	-3.98%
1/14/2022	\$99.53	-	\$99.48	\$99.73	388,572	0.51%
1/18/2022	\$96.25	-	\$96.25	\$96.39	263,229	-3.35%
1/19/2022	\$96.47	-	\$96.46	\$96.60	176,226	0.23%
1/20/2022	\$96.51	-	\$96.35	\$96.51	482,439	0.04%
1/21/2022	\$92.06	-	\$92.01	\$92.09	312,551	-4.72%
1/24/2022	\$97.35	-	\$97.34	\$97.48	474,439	5.59%
1/25/2022	\$95.32	-	\$95.31	\$95.45	670,077	-2.11%
1/26/2022	\$92.83	-	\$92.83	\$92.93	338,552	-2.65%
1/27/2022	\$91.50	-	\$91.26	\$91.50	220,720	-1.44%
1/28/2022	\$95.52	-	\$95.44	\$95.51	473,446	4.30%
1/31/2022	\$99.22	-	\$99.06	\$99.17	574,572	3.80%
2/1/2022	\$101.42	-	\$101.25	\$101.42	287,563	2.19%
2/2/2022	\$99.95	-	\$99.95	\$100.11	225,971	-1.46%
2/3/2022	\$97.44	-	\$97.28	\$97.59	270,240	-2.54%
2/4/2022	\$97.88	-	\$97.85	\$97.99	289,752	0.45%
2/7/2022	\$98.27	-	\$98.10	\$98.40	186,571	0.40%
2/8/2022	\$98.39	-	\$98.24	\$98.39	335,661	0.12%
2/9/2022	\$101.91	-	\$101.82	\$101.91	424,496	3.52%
2/10/2022	\$98.81	-	\$98.80	\$98.81	694,463	-3.09%
2/11/2022	\$97.57	-	\$97.37	\$97.57	485,147	-1.26%
2/14/2022	\$97.47	-	\$97.46	\$97.74	281,266	-0.10%
2/15/2022	\$101.00	-	\$100.88	\$101.04	204,632	3.56%
2/16/2022	\$97.52	-	\$97.49	\$97.71	536,529	-3.51%
2/17/2022	\$82.28	-	\$82.27	\$82.44	1,708,526	-16.99%



**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
2/18/2022	\$82.38	-	\$82.28	\$82.38	956,472	0.12%
2/22/2022	\$79.66	-	\$79.56	\$79.66	819,876	-3.36%
2/23/2022	\$77.54	-	\$77.54	\$77.55	725,461	-2.70%
2/24/2022	\$81.22	-	\$81.17	\$81.22	1,198,689	4.64%
2/25/2022	\$84.72	-	\$84.72	\$84.80	854,555	4.22%
2/28/2022	\$87.12	-	\$87.12	\$87.28	532,476	2.79%
3/1/2022	\$85.40	-	\$85.40	\$85.47	312,238	-1.99%
3/2/2022	\$85.99	-	\$85.99	\$86.05	233,143	0.69%
3/3/2022	\$83.13	-	\$83.13	\$83.23	432,749	-3.38%
3/4/2022	\$82.21	-	\$82.18	\$82.29	336,769	-1.11%
3/7/2022	\$79.28	-	\$79.13	\$79.28	558,677	-3.63%
3/8/2022	\$77.20	-	\$77.06	\$77.20	776,451	-2.66%
3/9/2022	\$80.23	-	\$80.17	\$80.25	1,066,567	3.85%
3/10/2022	\$78.68	-	\$78.68	\$78.69	463,621	-1.95%
3/11/2022	\$73.13	-	\$73.15	\$73.19	703,706	-7.32%
3/14/2022	\$72.27	-	\$72.27	\$72.35	631,754	-1.18%
3/15/2022	\$73.54	-	\$73.49	\$73.54	772,775	1.74%
3/16/2022	\$75.86	-	\$75.76	\$75.86	897,764	3.11%
3/17/2022	\$78.00	-	\$77.94	\$77.99	705,787	2.78%
3/18/2022	\$79.57	-	\$79.52	\$79.57	554,214	1.99%
3/21/2022	\$79.02	-	\$79.02	\$79.10	472,916	-0.69%
3/22/2022	\$82.31	-	\$82.22	\$82.32	610,578	4.08%
3/23/2022	\$79.52	-	\$79.41	\$79.54	287,913	-3.45%
3/24/2022	\$79.61	-	\$79.51	\$79.62	309,801	0.11%
3/25/2022	\$77.82	-	\$77.76	\$77.82	227,752	-2.27%
3/28/2022	\$79.82	-	\$79.70	\$79.82	260,576	2.54%
3/29/2022	\$82.71	-	\$82.64	\$82.71	359,195	3.56%
3/30/2022	\$80.80	-	\$80.67	\$80.80	198,840	-2.34%
3/31/2022	\$80.65	\$0.03	\$80.55	\$80.68	288,675	-0.15%
4/1/2022	\$80.24	-	\$80.20	\$80.24	388,127	-0.51%
4/4/2022	\$81.45	-	\$81.30	\$81.45	283,887	1.50%
4/5/2022	\$78.25	-	\$78.24	\$78.34	576,094	-4.01%
4/6/2022	\$74.94	-	\$74.94	\$75.13	325,470	-4.32%
4/7/2022	\$75.85	-	\$75.87	\$75.90	525,485	1.21%
4/8/2022	\$73.78	-	\$73.78	\$73.82	399,310	-2.77%
4/11/2022	\$75.74	-	\$75.66	\$75.73	551,731	2.62%
4/12/2022	\$76.00	-	\$75.94	\$75.99	370,045	0.34%
4/13/2022	\$76.76	-	\$76.67	\$76.76	275,561	1.00%
4/14/2022	\$74.51	-	\$74.51	\$74.62	380,518	-2.98%
4/18/2022	\$74.11	-	\$74.04	\$74.11	273,497	-0.54%
4/19/2022	\$75.73	-	\$75.64	\$75.73	239,964	2.16%
4/20/2022	\$74.42	-	\$74.42	\$74.52	320,072	-1.74%
4/21/2022	\$72.44	-	\$72.44	\$72.53	437,429	-2.70%
4/22/2022	\$71.94	-	\$71.94	\$71.96	392,894	-0.69%
4/25/2022	\$73.27	-	\$73.27	\$73.31	478,179	1.83%
4/26/2022	\$69.45	-	\$69.45	\$69.50	426,390	-5.35%
4/27/2022	\$68.66	-	\$68.68	\$68.85	339,207	-1.14%
4/28/2022	\$71.66	-	\$71.66	\$71.75	477,414	4.28%



**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
4/29/2022	\$76.59	-	\$76.51	\$76.59	969,564	6.65%
5/2/2022	\$74.47	-	\$74.49	\$74.52	480,352	-2.81%
5/3/2022	\$72.82	-	\$72.82	\$72.90	361,338	-2.24%
5/4/2022	\$75.79	-	\$75.76	\$75.83	521,070	4.00%
5/5/2022	\$70.19	-	\$70.19	\$70.27	298,138	-7.68%
5/6/2022	\$68.54	-	\$68.39	\$68.54	423,755	-2.38%
5/9/2022	\$65.93	-	\$65.95	\$65.99	347,165	-3.88%
5/10/2022	\$52.25	-	\$52.23	\$52.25	6,174,698	-23.26%
5/11/2022	\$48.07	-	\$48.06	\$48.07	1,826,540	-8.34%
5/12/2022	\$52.73	-	\$52.70	\$52.73	1,487,766	9.25%
5/13/2022	\$53.34	-	\$53.34	\$53.39	786,372	1.15%
5/16/2022	\$50.42	-	\$50.41	\$50.50	785,089	-5.63%
5/17/2022	\$49.90	-	\$49.86	\$49.90	637,753	-1.04%
5/18/2022	\$46.98	-	\$46.96	\$47.00	596,909	-6.03%
5/19/2022	\$48.77	-	\$48.72	\$48.77	745,243	3.74%
5/20/2022	\$48.48	-	\$48.48	\$48.49	508,590	-0.60%
5/23/2022	\$48.53	-	\$48.53	\$48.55	421,951	0.10%
5/24/2022	\$46.54	-	\$46.53	\$46.60	304,020	-4.19%
5/25/2022	\$47.79	-	\$47.72	\$47.79	450,027	2.65%
5/26/2022	\$47.70	-	\$47.68	\$47.70	409,726	-0.19%
5/27/2022	\$50.45	-	\$50.44	\$50.55	491,182	5.61%
5/31/2022	\$49.54	-	\$49.51	\$49.59	504,683	-1.82%
6/1/2022	\$50.26	-	\$50.22	\$50.26	389,050	1.44%
6/2/2022	\$54.73	-	\$54.73	\$54.81	398,965	8.52%
6/3/2022	\$52.47	-	\$52.46	\$52.50	417,565	-4.22%
6/6/2022	\$53.01	-	\$52.91	\$53.01	292,363	1.02%
6/7/2022	\$54.01	-	\$53.95	\$54.01	263,803	1.87%
6/8/2022	\$54.25	-	\$54.25	\$54.31	324,492	0.44%
6/9/2022	\$52.12	-	\$52.12	\$52.17	397,893	-4.01%
6/10/2022	\$49.35	-	\$49.30	\$49.36	246,729	-5.46%
6/13/2022	\$45.91	-	\$45.85	\$45.93	704,671	-7.23%
6/14/2022	\$45.58	-	\$45.57	\$45.63	509,236	-0.72%
6/15/2022	\$46.45	-	\$46.34	\$46.45	437,231	1.89%
6/16/2022	\$44.01	-	\$44.00	\$44.05	502,897	-5.40%
6/17/2022	\$46.53	-	\$46.49	\$46.53	554,138	5.57%
6/21/2022	\$46.85	-	\$46.86	\$46.90	341,900	0.69%
6/22/2022	\$46.94	-	\$46.95	\$47.04	652,304	0.19%
6/23/2022	\$50.41	-	\$50.37	\$50.41	634,730	7.13%
6/24/2022	\$52.72	-	\$52.71	\$52.72	683,266	4.48%
6/27/2022	\$51.72	-	\$51.68	\$51.72	443,675	-1.92%
6/28/2022	\$49.41	-	\$49.41	\$49.45	336,659	-4.57%
6/29/2022	\$49.16	-	\$49.11	\$49.16	509,656	-0.51%
6/30/2022	\$47.84	\$0.03	\$47.84	\$47.88	1,326,847	-2.66%
7/1/2022	\$49.46	-	\$49.38	\$49.46	393,827	3.33%
7/5/2022	\$51.26	-	\$51.27	\$51.29	475,846	3.57%
7/6/2022	\$50.29	-	\$50.22	\$50.30	368,129	-1.91%
7/7/2022	\$50.53	-	\$50.50	\$50.52	380,546	0.48%
7/8/2022	\$50.15	-	\$50.08	\$50.15	168,007	-0.75%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
7/11/2022	\$48.40	-	\$48.35	\$48.40	306,421	-3.55%
7/12/2022	\$47.11	-	\$47.06	\$47.11	492,843	-2.70%
7/13/2022	\$45.52	-	\$45.52	\$45.54	723,006	-3.43%
7/14/2022	\$44.78	-	\$44.78	\$44.80	442,924	-1.64%
7/15/2022	\$46.20	-	\$46.18	\$46.20	273,260	3.12%
7/18/2022	\$46.09	-	\$46.05	\$46.09	261,355	-0.24%
7/19/2022	\$47.75	-	\$47.73	\$47.75	331,474	3.54%
7/20/2022	\$50.00	-	\$49.99	\$50.00	524,457	4.60%
7/21/2022	\$50.69	-	\$50.67	\$50.69	458,170	1.37%
7/22/2022	\$50.07	-	\$50.01	\$50.07	399,378	-1.23%
7/25/2022	\$47.82	-	\$47.72	\$47.82	377,479	-4.60%
7/26/2022	\$46.37	-	\$46.31	\$46.37	399,097	-3.08%
7/27/2022	\$47.55	-	\$47.45	\$47.53	726,127	2.51%
7/28/2022	\$40.24	-	\$40.21	\$40.24	1,884,041	-16.69%
7/29/2022	\$40.15	-	\$40.15	\$40.16	1,185,015	-0.22%
8/1/2022	\$40.42	-	\$40.36	\$40.42	914,837	0.67%
8/2/2022	\$39.82	-	\$39.82	\$39.86	675,407	-1.50%
8/3/2022	\$40.31	-	\$40.31	\$40.35	346,559	1.22%
8/4/2022	\$38.70	-	\$38.70	\$38.75	456,275	-4.08%
8/5/2022	\$38.95	-	\$38.94	\$38.99	446,791	0.64%
8/8/2022	\$40.72	-	\$40.72	\$40.75	761,049	4.44%
8/9/2022	\$38.85	-	\$38.85	\$38.87	605,581	-4.70%
8/10/2022	\$40.43	-	\$40.43	\$40.48	398,274	3.99%
8/11/2022	\$40.61	-	\$40.61	\$40.64	859,593	0.44%
8/12/2022	\$42.17	-	\$42.17	\$42.20	574,298	3.77%
8/15/2022	\$42.41	-	\$42.38	\$42.41	402,356	0.57%
8/16/2022	\$41.81	-	\$41.81	\$41.85	318,234	-1.42%
8/17/2022	\$40.60	-	\$40.60	\$40.63	460,772	-2.94%
8/18/2022	\$40.46	-	\$40.46	\$40.51	582,092	-0.35%
8/19/2022	\$39.04	-	\$39.01	\$39.05	381,214	-3.57%
8/22/2022	\$37.42	-	\$37.42	\$37.44	467,656	-4.24%
8/23/2022	\$36.21	-	\$36.22	\$36.24	659,764	-3.29%
8/24/2022	\$36.57	-	\$36.54	\$36.57	395,730	0.99%
8/25/2022	\$37.08	-	\$37.08	\$37.11	317,572	1.38%
8/26/2022	\$36.24	-	\$36.25	\$36.26	533,802	-2.29%
8/29/2022	\$36.27	-	\$36.23	\$36.27	465,487	0.08%
8/30/2022	\$36.46	-	\$36.46	\$36.50	574,458	0.52%
8/31/2022	\$36.61	-	\$36.59	\$36.61	708,188	0.41%
9/1/2022	\$36.78	-	\$36.73	\$36.78	681,783	0.46%
9/2/2022	\$35.66	-	\$35.66	\$35.69	352,336	-3.09%
9/6/2022	\$35.35	-	\$35.35	\$35.39	464,531	-0.87%
9/7/2022	\$36.00	-	\$36.00	\$36.03	406,951	1.82%
9/8/2022	\$38.24	-	\$38.24	\$38.27	548,635	6.04%
9/9/2022	\$40.03	-	\$40.00	\$40.03	541,694	4.57%

**Exhibit-4****Pegasystems Common Stock Prices, Dividends, Volume, and Returns**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Dividend</b>	<b>PEGA Closing Bid</b>	<b>PEGA Closing Ask</b>	<b>PEGA Trading Volume</b>	<b>PEGA Logarithmic Return</b>
9/12/2022	\$41.67	-	\$41.64	\$41.67	517,107	4.02%
9/13/2022	\$39.80	-	\$39.73	\$39.80	475,501	-4.59%
9/14/2022	\$39.95	-	\$39.92	\$39.95	497,683	0.38%
9/15/2022	\$40.24	-	\$40.24	\$40.27	387,081	0.72%

**Sources:** CRSP and computations performed by Crowninshield Financial Research, Inc.

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Aberdeen Standard Investments (Edinburgh)	3,326	59,808	219,044	248,632	361,178
abrdrn Inc.	430,032	150,510	55,186	51,422	94,848
abrdrn Investments Limited	133,060	133,060	-	-	-
Acadian Asset Management LLC	7,017	8,308	207	4,913	34,017
Adage Capital Management, L.P.	-	45,000	80,000	-	-
Advisors Asset Management, Inc.	-	-	-	-	-
AGF Investments LLC	-	177	164	-	-
AHL Partners LLP	32,573	42,766	33,421	26,340	21,459
Alaska Retirement Management Board	-	-	4,156	-	-
Algert Global LLC	-	-	-	2,038	3,847
AllianceBernstein L.P.	43,090	23,140	23,110	20,806	21,820
Allianz Global Investors GmbH	54,383	74,486	115,516	156,741	-
Allianz Global Investors U.S. LLC	1,247	10	-	-	-
Allied Asset Advisors, Inc.	-	-	-	-	-
Allspring Global Investments, LLC	11,156	10,956	7,302	4,824	23,080
Allworth Financial, L.P.	-	-	-	-	-
Alpha Paradigm Partners, LLC	-	-	-	4,620	8,447
Alphacrest Capital Management LLC	4,000	6,900	4,600	10,402	6,660
AlphaSimplex Group, LLC	-	7,164	7,164	7,164	7,164
Alphastar Capital Management, LLC	-	-	-	-	-
Alpine Global Management, LLC	-	-	-	-	-
Altshuler Shaham Ltd.	428	608	1,979	-	-
Amalgamated Bank Institutional Asset Management & Custody	7,838	7,663	7,666	7,089	7,833
Amalgamated Financial Corp._NLE	-	-	-	-	-
American Century Investment Management, Inc	4,691	-	243,544	-	-
American Portfolios Advisors, Inc	74	74	74	74	74
American Trust Retirement	1,139	1,530	1,399	874	1,058
Amundi Asset Management, SAS	71	72	11,018	60	59
Andbank Wealth Management, SGIIC, S.A.U.	122	122	-	-	-
Aperio Group, LLC	24,231	24,144	24,452	25,239	25,366
AQR Capital Management, LLC	28,363	30,574	25,867	24,779	22,107
Arizona State Retirement System	8,990	12,083	11,660	11,746	10,996
Arkadios Wealth Advisors LLC	100	100	100	100	100
ArrowMark Colorado Holdings, LLC	3,525	5,262	-	-	-
Arrowstreet Capital, Limited Partnership	164,769	128,800	53,398	120,948	62,059

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Assenagon Asset Management S.A.	-	7,224	5,114	3,202	5,114
Asset Management One Co., Ltd.	-	-	-	647	647
Asset Management One USA Inc.	712	578	612	768	736
Assetmark, Inc.	-	-	-	04	-
Associated Investment Management, LLC	19	19	19	19	-
Atlas Private Wealth Advisors	-	10	10	10	10
Atom Investors LP	-	-	-	-	-
AtonRa Partners S.A. (Asset Management)	-	-	-	-	-
Avantis Investors	95	95	95	300	300
Avior Wealth Management, LLC	-	-	-	-	4,276
Aviva Investors Global Services Limited	23,410	18,886	10,431	10,486	-
B. Riley Asset Management, LLC	-	-	-	-	-
Bahl & Gaynor, Inc.	44,402	35,005	7,580	-	-
Balyasny Asset Management LP	65,973	-	-	33,747	10,109
Banco Santander International SA	-	-	-	14,274	-
Bank of Nova Scotia	82,001	67,206	110,393	94,396	141,396
Bank Vontobel AG	-	-	-	-	-
Barclays Bank PLC	1,600	1,600	16,004	9,521	3,331
Barclays Capital	-	-	-	-	-
Barclays Capital Inc.	-	23	11	-	-
Barclays Wealth	978	890	1,037	1,205	1,291
Bares Capital Management, Inc.	4,716,487	4,697,165	5,207,286	5,144,720	5,042,593
Barings LLC	-	24	-	214	214
Baron Capital Management, Inc.	1,234,028	1,233,941	1,243,650	1,303,269	1,301,685
Baystate Wealth Management LLC	-	-	-	08	08
BDO Wealth Advisors, LLC	-	-	-	-	-
Bell Investment Advisors, Inc.	-	-	-	-	-
Bellwether Wealth	-	-	-	-	-
BerganKDV Wealth Management, LLC	-	10	-	-	-
Berman Capital Advisors, LLC	48	48	48	48	56
Bessemer Trust Company, N.A. (US)	42,599	31,065	118,465	86,799	86,902
BG Fund Management Luxembourg S.A.	-	-	-	-	-
BI Asset Management Fondsmæglerselskab A/S	1,940	-	-	-	-
BlackRock (Netherlands) B.V.	6,551	5,483	4,968	2,641	4,497
BlackRock Advisors (UK) Limited	748	799	799	749	749

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
BlackRock Asset Management Canada Limited	697	777	777	670	670
BlackRock Asset Management Ireland Limited	14,537	16,558	25,286	29,128	31,277
BlackRock Financial Management, Inc.	96,019	97,960	98,855	90,379	96,079
BlackRock Institutional Trust Company, N.A.	1,796,890	1,734,549	1,763,408	1,771,572	1,653,403
BlackRock Investment Management (Australia) Ltd	226	226	226	180	403
BlackRock Investment Management (UK) Ltd	76,670	55,584	71,855	63,823	59,433
BlackRock Investment Management, LLC	21,098	18,793	19,602	18,799	20,838
BlackRock Japan Co., Ltd.	-	-	-	202	1,201
Blue Box Wealth Management SA	-	9,330	9,330	78,300	116,860
Blueshift Asset Management, LLC	-	-	-	2,688	-
BMO Asset Management Inc.	-	-	-	25	25
BMO Asset Management U.S.	14,423	-	-	-	-
BMO Capital Markets (US)	20	26	15	23	18
BMO Family Office, LLC	1,019	1,019	1,008	848	848
BMO Harris Bank N.A.	6,234	4,049	4,049	4,101	4,051
BNP Paribas Securities Corp. North America	13,451	3,410	3,410	3,771	2,468
BNY Mellon Asset Management	119,817	77,697	80,929	86,966	72,213
BNY Mellon Wealth Management	9,263	13,951	14,796	14,271	12,817
BofA Global Research (US)	184,447	200,900	196,649	202,132	195,198
Bogart Wealth, LLC	-	-	-	09	10
Boothbay Fund Management, LLC	-	-	8,509	-	-
Boston Partners	1,213	532	473	473	473
Bridgefront Capital, LLC	-	-	-	-	-
Bridgewater Associates, LP	-	-	-	-	-
Brinker Capital Investments, LLC	-	1,659	-	-	-
Brown Advisory	-	-	3,325	-	-
Brown Brothers Harriman & Company	21,605	21,605	21,605	21,605	20,676
BTC Capital Management, Inc.	-	-	1,570	-	-
Cadian Capital Management LP	1,557,654	1,803,366	2,045,328	349,413	-
Calamos Advisors LLC	9,573	9,469	12,292	7,393	4,677
California Public Employees' Retirement System	88,147	90,264	97,152	85,557	84,141
California State Teachers Retirement System	67,707	69,490	70,905	70,406	70,921
Callan LLC	14,615	-	-	-	-
Calvert Research and Management	6,144	6,219	7,190	7,357	6,257
Cambridge Investment Research Advisors, Inc	-	-	-	-	1,646

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Cambridge Trust Company	5,000	5,000	5,000	5,000	5,000
Campbell & Company, Inc.	2,510	-	1,799	-	-
Capital Advisors, Ltd., LLC	-	-	-	-	-
Capital International, Inc.	-	-	-	-	3,827
Capital Research Global Investors	721,266	721,266	711,616	711,616	933,902
Capstone Triton Financial Group, LLC	-	-	477	-	-
CAPTRUST Financial Advisors	382	383	353	509	611
Capula Investment Management LLP	-	-	-	-	1,838
Carne Global Fund Managers (Ireland) Limited	-	-	-	-	-
Carolinas Wealth Consulting LLC	-	31	-	-	-
Carroll Financial Associates, Inc.	1,613	1,613	1,608	1,608	1,608
Carson Wealth Management Group	-	-	-	-	-
CastleArk Management, LLC	79,685	21,745	19,735	-	-
Cathay Securities Investment Trust Co., Ltd.	6,059	3,886	5,039	5,721	6,171
CenterBook Partners LP	-	-	-	-	-
Centiva Capital, LP	4,837	4,543	2,535	-	4,714
Central Trust & Investment Company	-	-	-	-	238
Cetera Advisor Networks LLC	291	-	-	-	-
CG Advisory Services	-	-	09	-	-
Charles Schwab Investment Management, Inc	282,650	206,494	213,530	213,706	219,572
Checchi Capital Advisers, LLC	241	-	-	-	-
CI Global Asset Management	29	43	34	34	55
CIBC Asset Management Inc.	2,877	2,950	2,950	2,946	2,946
Circle Wealth Management, LLC	2,792	-	-	-	-
Citadel Advisors LLC	117,414	26,258	60,465	66,477	12,048
Citi Investment Research (US)	93,254	62,504	61,551	52,856	54,938
City National Rochdale, LLC	316	318	318	345	361
ClearArc Capital, Inc._NLE	1,833	1,833	1,833	1,833	1,833
Clearline Capital LP	-	-	-	-	-
Columbia Threadneedle Investments (US)	53,232	3,573	3,352	4,351	7,075
Column Capital Advisors, LLC	86	77	77	77	77
Comerica, Inc.	-	317	317	-	55,937
Commonwealth Financial Network	5,222	11,496	12,047	5,115	12,658
Concord Wealth Partners	-	-	38	38	38
Connor, Clark & Lunn Investment Management Ltd	-	-	-	-	-

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Corbenic Partners, LLC_NLE	-	-	-	114	114
Cornerstone Advisors, Inc. (WA)	34	34	34	34	34
Cornerstone Advisory, LLC	-	-	-	-	-
Covestor, Ltd.	-	-	-	-	-
CPP Investment Board	11,400	-	-	-	-
Crawford Investment Counsel, Inc.	119,853	112,106	109,540	91,234	85,063
Creative Planning, Inc.	-	2,626	-	-	1,528
Credit Suisse Funds AG	42,146	43,705	43,371	40,665	41,754
Credit Suisse International	-	-	-	56	30
Credit Suisse Securities (Europe) Limited	-	-	37	621	-
Credit Suisse Securities (USA) LLC	532	2,830	6,790	1,397	5,188
Cresset Asset Management, LLC	2,369	2,369	2,401	2,441	2,506
Crestline Investors, Inc.	110,093	-	-	-	-
Cubist Systematic Strategies, LLC	21,427	16,346	26,056	37,060	-
Curi Capital	-	-	-	-	-
Cutler Group, LP	-	-	-	-	-
CVA Family Office, LLC	-	-	-	-	42
D. E. Shaw & Co., L.P.	-	-	-	-	-
Danske Bank Asset Management	1,200	1,900	2,300	4,600	3,148
Danske Bank Oyj	800	1,200	900	900	900
Dara Capital US, Inc.	-	-	150	182	154
Dark Forest Capital Management LP	-	-	-	-	-
DBX Advisors LLC.	719	695	958	969	-
DeepCurrents Investment Group LLC	-	13,800	13,327	-	-
Deutsche Asset Management Americas	392,950	380,626	382,821	372,609	369,143
Dimensional Fund Advisors Canada ULC	-	-	-	100	100
Dimensional Fund Advisors, L.P.	284,464	283,067	255,245	244,191	215,857
Dimensional Fund Advisors, Ltd.	16,741	18,365	17,447	16,756	17,948
Diversified Trust Company	-	-	-	-	2,930
Dorsal Capital Management, LLC	800,000	1,000,000	575,000	175,000	-
Duality Group	-	2,920	23,342	22,045	-
Dubuque Bank and Trust Company	3,265	3,265	3,265	3,265	2,270
DWS Investment GmbH	2,144	2,144	2,144	21,438	21,363
DWS Investment Management Americas, Inc.	621	285	285	50	-
DWS Investments UK Limited	638	494	422	458	494



**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Dynamic Technology Lab Pte. Ltd.	5,448	4,579	3,832	13,636	-
E*TRADE Capital Management LLC	5,287	4,101	-	-	-
Eagle Asset Management, Inc.	1,209,231	1,104,584	956,518	841,337	710,190
Eagle Bay Advisors LLC	-	-	-	-	-
EAM Investors, LLC	12,623	9,167	-	-	-
Eaton Vance Management	-	-	-	550	508
Elequin Capital, L.P.	-	-	-	-	-
Elkfork Partners LLC	462	462	462	462	462
Ellevest, Inc.	55	82	295	136	136
Emerald Advisers LLC	4,012	5,062	4,882	4,692	4,692
Eminence Capital, LP	-	299,180	439,810	813,152	781,998
Engineers Gate Manager, L.P.	-	3,823	-	7,942	-
Engle Capital Management, L.P.	80,000	250,000	312,000	83,000	-
Ensign Peak Advisors, Inc.	14,020	78,020	113,550	190,616	359,378
Enterprise Financial Services Corp.	07	07	07	13	07
Envestnet Asset Management, Inc.	37,447	46,896	48,320	54,178	61,054
Equis Capital Management, Inc.	-	-	-	-	-
Ergoteles Capital	-	-	-	-	6,002
ETF Managers Group, LLC	-	-	-	-	-
Ethical Capital Opportunity Advisors Ltd	-	-	-	-	-
Eurizon Capital S.A.	-	-	-	755	1,200
Evelyn Partners Investment Management LLP	127,327	127,327	156,221	156,221	-
EverSource Wealth Advisors, LLC	-	-	-	-	-
Evolve Funds Group Inc	-	-	-	577	737
EVR Research LP	-	-	-	-	-
Exchange Traded Concepts, LLC	330	92	2,442	861	-
ExodusPoint Capital Management, LP	2,257	19,625	-	3,322	2,299
Exponential ETFs	102	116	-	-	-
FDX Advisors, Inc.	-	6,333	7,950	9,768	11,735
Federated Hermes Investment Management Company	-	-	-	-	-
Federated MDTA LLC	29,823	29,263	26,974	26,974	26,974
Fidelity Institutional Asset Management	125,206	8,511	7,901	8,208	8,208
Fidelity International	-	-	-	-	256
Fidelity Investments Canada ULC	2,628	20,750	13,648	13,648	13,648
Fidelity Management & Research Company LLC	338,626	216,867	121,979	67,374	69,172

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Fiera Capital Corporation	33,895	32,947	-	-	-
FIL Investment Management (Australia) Limited	5,300	5,300	-	-	-
FinTrust Capital Advisors, LLC	970	850	850	-	-
First Horizon Advisors, Inc.	473	474	-	-	474
First Trust Advisors L.P.	275,580	325,499	299,982	177,643	41,952
Fisher Investments	816,169	724,270	733,003	724,112	696,981
Flagship Harbor Advisors LLC	166	176	-	-	-
Florida State Board of Administration	61,620	61,620	59,040	56,250	51,875
Fora Capital LLC	1,573	138	-	655	-
Fortis Capital Management, L.L.C	-	-	-	16,137	7,837
Founders Financial Alliance, LLC	-	125	-	-	-
Foxhaven Asset Management, LP	1,042,083	871,529	591,457	1,119,465	1,119,465
Fred Alger Management, LLC	-	-	322	322	-
Frontier Capital Management Company, LLC	-	30,531	27,246	41,668	50,374
Fulcrum Asset Management LLP	-	-	-	4,306	-
GAM International Management Ltd.	58,418	59,352	77,647	74,811	161,904
Geneos Wealth Management Inc	-	-	-	-	-
Geode Capital Management, L.L.C.	484,101	472,037	499,187	517,663	530,360
George Kaiser Family Foundation	-	37,699	44,900	60,381	67,079
Glassman Wealth Services LLC	20	20	20	20	20
Glen Harbor Capital Management LLC_NLE	714	714	714	714	714
GLG Partners LP	-	-	7,183	700	-
Global Beta Advisors LLC	-	-	-	-	-
Global X Management (AUS) Limited	21,656	24,375	28,643	64,875	75,705
Goldman Sachs & Company, Inc.	232,975	321,752	349,213	332,849	401,824
Goldman Sachs Advisors B.V.	-	-	-	-	-
Goldman Sachs Asset Management B.V.	-	-	-	-	-
Goldman Sachs Asset Management, L.P.	72,724	57,307	55,986	68,002	70,764
Gotham Asset Management, LLC	-	-	-	-	2,978
Graham Capital Management, L.P.	-	-	-	-	-
Graham Partners LP	-	-	-	-	-
Graubündner Kantonalbank	43	-	-	-	-
Greenwood Capital Associates, LLC	4,524	5,157	6,934	6,831	7,062
Group One Trading, L.P.	-	-	-	100	41
GSA Capital Partners LLP	-	8,315	-	-	11,948

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Guggenheim Investments	-	-	-	-	-
Guinness Atkinson Asset Management Inc.	-	-	66	660	660
GW&K Investment Management, LLC	10,179	10,179	11,666	5,674	-
GWL Investment Management Ltd.	38,245	37,421	51,393	120,719	125,545
Gyon Technologies Capital Management, LP	-	-	-	-	-
H. M. Payson & Co.	50	50	50	50	50
Handelsbanken Kapitalförvaltning AB	9,344	9,344	9,344	7,444	7,444
Hardy Reed, LLC	2,206	2,206	2,184	2,184	2,184
Harvest Fund Management Co., Ltd.	-	631	-	-	-
Hawk Ridge Capital Management LP	-	-	-	-	-
HC Financial Advisors, Inc.	150	150	150	150	150
Hennion & Walsh Asset Management, Inc.	-	-	-	-	-
Herald Investment Management Limited	335,300	335,300	319,000	319,000	319,000
Highside Global Management LLC	107,713	93,813	134,113	134,113	-
Highstreet Asset Management Inc.	14	14	14	14	14
Hightower Advisors, LLC	7,429	7,768	7,921	8,087	8,395
Holocene Advisors, LP	-	-	-	-	-
HOOPP Investment Management	12,000	-	-	-	-
Horizons ETFs Management (Canada) Inc.	-	-	-	-	-
HRT Financial LP	-	2,918	3,323	-	32,404
HSBC Global Asset Management (UK) Limited	1,987	6,387	6,549	6,329	5,193
Huntington Private Financial Group	233	297	297	272	149
Icon Wealth Partners, LLC	-	6,304	8,072	10,315	11,706
ID-Sparinvest A/S	-	-	2,091	2,091	2,091
IFAM Capital	40	40	39	25	25
Illinois Municipal Retirement Fund	-	5,073	9,531	9,531	9,531
Independent Advisor Alliance, LLC	-	3,202	3,238	3,215	3,209
Independent Financial Partners	-	-	-	-	-
ING Bank N.V.	-	-	-	-	-
Innealta Capital, LLC	-	-	-	-	05
Insight Advisors, LLC	-	-	1,974	1,974	2,816
Inspire Investing	-	-	-	-	-
Interchange Capital Partners LLC	-	-	47	-	-
International Assets Investment Management, LLC	-	-	100	100	-
Invesco Advisers, Inc.	1,305,598	1,746,915	1,728,870	1,710,841	1,705,064

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
INVESCO Asset Management Deutschland GmbH	-	-	100	271	231
Invesco Capital Management LLC	142,329	139,522	128,629	70,142	64,200
Irish Life Investment Managers Ltd.	38,245	34,434	51,215	120,871	126,076
Ironwood Investment Management, LLC	48,926	48,464	47,508	47,467	46,711
J.P. Morgan Investment Management, Inc. (SI)	130	128	17,519	19,941	19,043
J.P. Morgan Private Wealth Advisors LLC	-	1,117	1,078	1,633	2,034
J.P. Morgan Securities LLC	95	6,130	95	95	113,738
J.P. Morgan Securities plc	27	2,230	-	4,592	6,589
Jacobs Levy Equity Management, Inc	-	-	-	-	-
Jane Street Capital, L.L.C.	14,667	2,057	3,833	62,045	-
Janus Henderson Investors	29,390	52,866	117,389	-	-
Jefferies LLC	-	-	-	-	-
Jennison Associates LLC	1,396	-	-	-	-
JFS Wealth Advisors, LLC	-	-	-	17	-
JP Morgan Alternative Asset Management, Inc.	1,500	1,500	-	-	-
JP Morgan Asset Management	2,432	2,545	19,732	22,412	21,757
JPMorgan Asset Management U.K. Limited	2,302	2,417	2,471	2,783	2,720
JPMorgan Private Bank (United States)	-	-	-	-	-
JT Stratford LLC	-	1,975	2,244	2,348	2,464
Jump Financial, LLC	-	-	-	-	-
Jupiter Asset Management Ltd.	5,024	5,024	5,024	5,024	-
Jupiter Wealth Management, LLC	-	-	-	-	3,000
Kaydan Wealth Management, Inc.	-	-	-	-	-
KB Asset Management Co., Ltd.	-	184	-	-	-
KBC Group NV	-	-	-	-	-
Kentucky Teachers' Retirement System	11,503	-	-	-	-
KeyBanc Capital Markets	-	-	-	-	-
KLP Fondsforvaltning AS	4,900	5,200	5,200	6,400	6,500
Knowledge Leaders Capital, LLC	-	-	-	-	6,142
L. Roy Papp & Associates, LLP	30,015	30,015	29,680	26,760	26,760
L2 Asset Management, LLC	21	21	22	22	27
Ladenburg Thalmann Asset Management Inc. (LTAM)	460	460	460	460	460
Landsberg, Bennett, & Dubbanek LLC	31,398	25,077	24,465	25,142	26,622
Lazard Asset Management, L.L.C.	-	-	-	340,829	371,421
Lee Capital Asset Management LLC	24,570	24,570	24,570	24,570	24,570

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Lee Capital Holdings LLC	44,730	45,681	13,150	38,250	-
Legal & General Investment Management Ltd	70,397	70,035	67,477	68,525	67,984
Lenox Wealth Advisors, LLC	250	-	-	-	-
Lindbrook Capital, LLC	68	68	68	103	103
Liontrust Investment Partners LLP	23,400	17,000	22,000	22,000	22,000
Lloyds Bank International Limited	1,358	1,358	-	-	-
Locust Wood Capital Advisers, LLC	-	114,230	116,975	-	367,766
Loomis, Sayles & Company, L.P	172,859	183,407	208,200	209,305	217,634
Los Angeles Capital Management LLC	10,554	9,974	8,494	6,629	6,489
LPL Financial LLC	7,101	7,948	7,805	7,920	8,064
LSV Asset Management	1,290	1,790	500	500	2,160
Luxor Capital Group, L.P.	2,908,698	3,107,163	3,046,975	3,950,604	3,444,521
M Capital Advisors	11,355	11,095	10,985	13,358	13,526
Macquarie Investment Management	-	-	280	220	292
Macquarie Investment Management Global Ltd.	1,800	2,000	2,000	1,556	1,556
Madison Avenue Partners LP	-	-	-	-	-
Magnetar Capital Partners LP	-	-	-	12,846	2,983
MainStreet Advisors	1,820	1,676	1,676	1,129	1,129
Makena Capital Management, LLC	45,780	34,605	40,502	100,239	114,114
Malaga Cove Capital, LLC	5,401	5,401	5,486	7,268	9,107
Managed Account Advisers LLC	156,410	147,242	139,923	142,958	142,325
Manchester Capital Management LLC	-	-	-	-	-
Manulife Investment Management (North America) Limited	1,661	1,661	1,661	-	1,661
Marshall Wace LLP	-	-	-	11,890	-
Martingale Asset Management, L.P.	-	2,302	2,304	-	-
Maryland Capital Management, LLC_NLE	-	1,723	2,746	3,693	3,881
Maryland State Retirement & Pension System	-	-	-	3,147	3,147
Maverick Capital, Ltd.	-	1,844	3,204	-	-
McIlrath & Eck, LLC	175	175	175	175	175
Meadow Creek Investment Management LLC	588	588	588	588	588
Mellon Investments Corporation	70,202	68,633	70,150	68,571	71,250
Melqart Asset Management (UK) Limited	-	-	7,086	96,867	30,401
Mercer Global Investments Management Ltd	-	-	11,616	46,496	56,910
Meridian Wealth Partners, L.L.C.	-	-	-	03	-
MetLife Investment Management, LLC	-	-	-	-	-

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
METROPOLE Gestion	1,213	532	473	473	473
Metropolitan Life Insurance Co. (US)	2,896	2,824	2,768	2,655	2,713
MFS Investment Management	600	600	500	500	300
MGO One Seven LLC	3,937	3,666	3,448	3,369	3,417
Mid-Continent Capital, LLC	-	15	45	45	45
Millennium Management LLC	16,957	83,323	81,174	115,754	26,551
Mirae Asset Global Investments (USA) LLC	2,077	2,981	3,863	12,586	12,540
Missouri Trust & Investment Company	-	-	-	-	-
MML Investors Services, LLC	-	-	-	-	1,888
Mont Blanc Capital Management AG	400	400	400	400	400
Morgan Stanley & Co. International Plc	-	-	01	01	-
Morgan Stanley & Co. LLC	8,996	620	27,409	27,548	13,508
Morgan Stanley Investment Management Inc. (US)	3,253	3,553	3,753	3,056	2,949
Morgan Stanley Smith Barney LLC	14,743	8,160	6,803	5,168	6,785
Motley Fool Asset Management, LLC	-	-	-	-	-
MUFG Securities EMEA plc	11,528	74,600	34,000	52,000	8,000
National Bank of Canada	-	-	-	-	-
National Bank Trust	29	29	21	21	22
Natixis Investment Managers SA	-	-	82	-	-
NBC Capital Advisors	-	100	-	-	-
Neiman Funds Management LLC	-	-	1,200	1,200	1,200
Neuberger Berman Asset Management Ireland Ltd	-	-	-	11,800	11,800
New Jersey Division of Investment	31,074	28,819	27,799	26,388	20,978
New York State Common Retirement Fund	63,950	57,950	53,050	46,550	46,550
Newton Investment Management North America, LLC	-	-	-	-	-
NEXT Financial Group, Inc.	-	09	09	09	35
NNIP Asset Management B.V. _NLE	-	-	-	-	-
Nomura Securities Co., Ltd.	-	-	8,000	-	4,000
Norges Bank Investment Management (NBIM)	462,235	378,107	358,547	331,620	344,170
North Run Capital, LP	50,000	21,500	-	77,500	62,000
Northern Trust Global Investments	112,921	112,765	124,313	136,000	134,459
Northern Trust Global Investments Limited	7,039	7,607	7,941	8,114	16,281
Northern Trust Investments, Inc.	197,301	193,600	190,061	194,373	183,984
Northwestern Mutual Capital, LLC	637	637	643	637	647
Numeric Investors LLC	-	-	-	-	-

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Nuveen Asset Management, LLC	-	-	-	-	-
Nuveen LLC	252,210	208,358	262,318	260,222	242,197
Nykredit Bank AS	-	-	2,091	901	901
Oak Thistle LLC	-	-	-	-	-
Ofi Asset Management_NLE	5,372	5,372	5,372	5,372	5,372
OFI Invest Asset Management	5,372	5,372	5,372	5,372	5,372
Ohio Public Employees Retirement System	14,898	15,465	19,688	21,242	23,613
Oppenheimer Asset Management Inc.	51,003	51,942	50,723	50,671	50,927
Osaic Holdings, Inc.	2,715	4,472	3,554	4,330	6,033
O'Shaughnessy Asset Management, LLC	-	04	01	06	06
Ostrum Asset Management	96,000	18,334	-	-	-
Outfitter Financial LLC	-	-	-	-	-
Pacifica Partners Inc.	400	-	-	-	-
Paloma Partners Management Company	3,889	-	-	5,098	-
PanAgora Asset Management Inc.	11	11	11	977	1,085
Paragon Wealth Strategies, LLC	-	-	-	-	708
Parallax Volatility Advisers, L.P.	-	-	-	-	-
Parallel Advisors, LLC	442	432	437	450	454
Parametric Portfolio Associates LLC	35,929	39,567	37,918	41,818	29,603
Parkside Financial Bank & Trust	1,733	1,565	1,668	1,552	1,567
PDT Partners, LLC	-	-	2,706	-	-
Peak 6 Capital Management, LLC	-	-	-	1,058	-
Penserra Capital Management LLC	-	-	66	660	18,818
Personal Capital Advisors Corporation	2,492	2,492	2,499	2,492	2,492
PFS Partners, LLC	-	-	-	-	-
PGIM Fixed Income	-	1,637	1,885	1,885	1,885
PGIM Investments LLC	-	-	-	-	-
PGIM Quantitative Solutions LLC	-	1,502	1,502	1,402	1,433
Pictet Asset Management Ltd.	1,600	3,200	3,200	3,200	2,929
PIMCO (US)	33	76	115	124	-
Ping An of China Asset Management (Hong Kong) Co., Ltd.	936	806	910	1,066	1,196
Pinnacle Financial Partners, Inc.	50	50	50	-	-
Pinnacle Wealth Planning Services, Inc.	-	-	14	-	-
PNC Investments LLC	7,932	9,605	8,630	9,030	9,305
Point72 Asset Management, L.P.	-	-	-	-	-

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Point72 Hong Kong Limited	1,124	2,557	-	-	-
Praesidium Investment Management Company, LLC	706,884	1,060,627	1,233,772	1,613,907	1,613,425
Princeton Capital Management LLC	4,000	4,000	4,000	4,000	4,000
Principal Global Investors (Equity)	5,602	4,771	4,587	4,242	4,385
Private Advisor Group LLC	288	-	-	-	-
Private Capital Group, LLC	257	244	51	244	244
Procyon Advisors, LLC	234	-	-	-	-
ProEquities Inc	41	86	330	701	846
ProFund Advisors LLC	347	464	455	368	318
ProShare Advisors LLC	-	1,749	1,896	1,991	2,114
Provenire Capital, LLC	-	11,360	30,627	1,746	5,608
Prudential Financial Planning Services,	-	-	-	2,102	2,260
Psagot Mutual Funds Ltd	-	-	-	-	2,081
PSP Investments	-	-	-	25,000	-
Public Employees' Retirement Association of CO	6,979	6,979	6,018	6,018	6,018
Quadrant Family Wealth Advisors	1,523	29	29	34	29
Quadrature Capital LLP	9,600	11,911	17,658	-	4,328
Quantbot Technologies, LP	-	-	1,196	-	139
Quantitative Investment Management LLC	-	-	-	-	4,957
Qube Research & Technologies Ltd	11,729	17,471	2,901	25,177	-
Quent Capital, LLC	-	-	-	-	-
Rafferty Asset Management LLC	-	-	-	-	-
RAM Active Investments S.A.	-	-	-	-	-
Ranger Investment Management, L.P.	550,595	546,750	486,986	440,624	430,539
Rational Advisors, Inc.	723	-	-	-	-
Raymond James & Associates, Inc.	18,150	18,436	18,737	16,629	16,503
Raymond James Financial Services Advisors, Inc.	-	-	1,752	1,806	1,741
RBC Brewin Dolphin	155	155	155	155	155
RBC Capital Markets Wealth Management	215,076	240,230	247,405	242,709	15,861
RBC Capital Partners	-	-	-	-	1,770
RBC Dominion Securities, Inc.	50	50	333	61	210
RBC Wealth Management, International	151	438	268	1,665	257,843
Redwood Investments, LLC	5,527	5,637	-	-	-
Regent Peak Wealth Advisors, LLC	-	-	03	-	-
Renaissance Technologies LLC	-	-	-	-	-



**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Repertoire Partners LP	-	-	-	-	-
Research Affiliates, LLC	33	76	115	124	-
Resolute Financial LLC	-	-	-	-	-
Reynolds Capital Management, LLC	300	1,900	-	-	450
Rhumblin Advisers Ltd. Partnership	45,628	43,985	43,294	41,276	39,171
Rice Hall James & Associates, LLC	117,020	81,006	62,164	60,401	48,872
Richard Bernstein Advisors LLC	39,586	39,586	-	-	-
Rise Advisors, LLC	-	-	-	-	-
Riverbridge Partners, LLC	1,215,811	1,224,535	1,342,570	1,312,146	1,369,540
Riverview Trust Co	-	-	-	-	-
Rockefeller Capital Management	-	-	-	-	23
Ropes Wealth Advisors LLC	-	201	-	-	-
Roubaix Capital, LLC	17,621	12,790	-	18,481	-
Russell Investments Limited	-	-	1,374	1,686	5,870
Russell Investments Trust Company	100,601	87,008	54,052	78,864	89,406
S.B. Carr Investments, Inc.	221	143	-	-	-
Sageworth Trust Co of South Dakota	-	-	-	-	-
Sageworth Trust Co.	-	-	-	1,430	1,430
Samsung Asset Management Co., Ltd.	134	123	123	123	123
Scholtz & Company, LLC	-	-	11,562	11,647	11,857
Schonfeld Strategic Advisors LLC	4,479	-	1,669	2,351	-
Schubert & Co	-	-	-	-	-
Schweizerische Nationalbank	88,900	90,800	90,800	92,200	89,200
ScienCast Management LP	-	-	-	-	-
Scout Investments, Inc.	132,764	-	-	-	-
Segall Bryant & Hamill, LLC	98,337	132,458	140,276	113,143	109,901
SEI Investments Management Corporation	36,525	32,220	29,682	31,126	32,899
Seven Eight Capital, LP	3,500	2,015	-	-	-
SG Americas Securities, L.L.C.	15,708	19,170	15,058	24,474	24,556
Shannon River Fund Management LLC	-	-	116,273	159,973	209,204
Sierra Capital LLC	-	-	-	-	-
Signaturefd, LLC	532	543	540	540	532
Simplex Trading, LLC	6,467	579	1,474	3,477	1,902
SinoPac Securities Investment Trust Co., Ltd.	-	-	-	700	378
Snowden Capital Advisors LLC	-	-	-	-	-

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Sound Income Strategies, LLC	-	03	03	03	-
Southpoint Capital Advisors LP	-	-	-	-	1,000,000
Sowell Management Services	59	44	44	1,898	-
Sparkline Capital LP	-	-	-	-	-
Spire Wealth Management, LLC	-	-	-	1,049	1,049
SQN Investors LP	755,677	607,147	554,788	-	-
Squarepoint Capital LLP	3,987	2,000	6,909	24,576	-
SRS Capital Advisors, Inc	-	-	-	-	-
Standard Family Office LLC	-	-	-	03	-
State of Wisconsin Investment Board	5,177	5,277	5,077	5,000	4,869
State of Wyoming	-	-	-	569	2,310
State Street Global Advisors (UK) Ltd.	1,798	1,798	-	-	-
State Street Global Advisors (US)	502,420	493,889	501,274	510,280	605,280
State Street Global Advisors Ireland Limited	2,188	2,294	3,368	3,886	3,885
State Teachers Retirement System of Ohio	13,382	11,252	12,251	12,939	-
Stephens Capital Management	2,219	1,719	1,826	-	-
Steward Partners Investment Advisory, LLC	300	300	300	300	300
Stone Ridge Asset Management LLC	2,443	2,443	2,443	2,443	2,443
Stonebridge Capital Advisors, LLC	-	-	-	12	12
Sturgeon Ventures LLP	-	23,145	30,261	40,009	39,149
Sumitomo Mitsui Trust Asset Management Co., Ltd	-	-	-	300	300
Sumitomo Mitsui Trust Bank, Limited	10,467	10,467	9,467	1,918	-
SunAmerica Asset Management, LLC	1,021	979	942	843	843
Susquehanna Fundamental Investments, LLC	-	14,600	14,600	14,600	16,537
Susquehanna International Group, LLP	-	2,549	5,294	5,219	4,008
Synovus Trust Company, N.A.	8,160	9,827	10,317	10,542	7,573
T. Rowe Price Associates, Inc.	805,010	731,652	600,728	297,522	379,221
TCI Wealth Advisors, Inc.	-	117	117	117	117
Teacher Retirement System of Texas	-	2,276	3,649	4,474	5,263
Thames Capital Management	-	-	-	-	20,874
The Colony Group, LLC	-	60,000	-	-	-
The Commerce Trust Company	-	-	-	-	27,245
The Connable Office, Inc.	2,905	2,905	2,905	2,905	2,905
The Harvest Group Wealth Management, LLC	-	-	11	-	-
The MassMutual Trust Company, FSB	-	-	-	-	-

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
The Treasurer of the State of North Carolina	14,475	14,455	14,495	14,455	14,195
The Vanguard Group, Inc.	3,654,525	3,535,069	3,602,213	3,680,486	3,723,921
Tinkoff Capital OOO	-	-	-	-	-
Tiverton Asset Management LLC_NLE	2,696	2,696	2,696	2,696	2,696
TOBAM	495	495	495	495	495
Toroso Asset Management	102	116	130	173	746
Total Clarity Wealth Management, Inc	-	-	-	150	-
Totem Point Management, LLC	270,700	268,645	211,129	137,396	-
Tower Research Capital LLC	1,185	2,169	980	3,880	177
TPG Capital, L.P.	1,682,111	1,327,163	1,191,530	982,530	1,081,965
Trellus Management Company, LLC	-	-	-	-	4,500
Trexquant Investment LP	16,513	11,066	6,996	8,546	3,358
TrinityPoint Wealth LLC	-	-	-	-	-
TruClarity Wealth Advisors	-	-	-	-	-
Trustcore Financial Services, LLC	2,175	-	-	-	-
Tudor Investment Corporation	9,139	6,806	3,745	15,437	-
Tuttle Capital Management, LLC	1,930	-	-	331	-
Twin Tree Management, LP	-	-	-	-	-
TwinBeech Capital LP	-	3,175	-	-	-
Two Sigma Investments, LP	15,958	-	74,029	37,401	-
Tyers Asset Management LLC	336	336	336	336	336
Tygh Capital Management, Inc._NLE	38,650	-	-	-	-
U.S. Bancorp Asset Management, Inc.	17,955	18,367	18,525	20,947	20,519
UBS Asset Management (Americas), Inc.	15,629	16,641	27,239	27,239	19,511
UBS Asset Management (Switzerland)	21,311	22,990	22,990	23,301	23,371
UBS Asset Management (UK) Ltd.	14,233	14,862	14,929	14,707	16,277
UBS Financial Services, Inc.	16,439	20,065	31,482	37,189	31,241
UMB Bank, NA	-	-	-	-	-
Union Bank & Trust Company (Nebraska)	-	-	-	-	-
University of Notre Dame du Lac	-	-	-	-	-
Utah Retirement Systems	7,499	7,599	7,799	7,499	7,799
Valeo Financial Advisors LLC	30	-	-	-	-
Value Partners Investments, Inc.	-	-	-	-	-
Vanguard Global Advisers LLC	21	53	87	125	270
Vanguard Investments Australia Ltd.	13,297	13,727	13,727	13,727	10,133

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Vanguard Personalized Indexing Management, LLC	-	-	-	-	2,755
Vantage Consulting Group, Inc.	-	-	05	-	-
Vaughan Nelson Investment Management, L.P.	128	128	128	128	74
Venturi Private Wealth	-	2,485	1,965	2,066	-
Veritas Asset Management LLP	-	29,263	26,974	-	-
Verition Fund Management LLC	-	5,049	4,432	4,981	1,938
Victory Capital Management Inc.	6,059	5,784	6,099	5,794	5,766
Virginia Retirement System	-	4,000	3,700	4,100	6,300
Virtu Americas LLC	-	1,930	-	3,478	-
Virtus Alternative Investment Advisers, Inc.	155	92	47	47	47
Virtus Investment Advisers, Inc.	1,998	1,998	1,998	1,998	1,998
Voloridge Investment Management, LLC	8,137	11,445	9,403	25,497	3,810
Voya Investment Management LLC	35,852	32,044	20,209	13,689	13,861
Walleye Capital LLC	-	1,982	-	-	-
Walleye Trading, LLC	2,139	3,454	-	2,847	10,367
Washington Capital Management, Inc.	-	-	-	-	-
Washington Harbour Partners L.P.	-	-	-	-	-
Wealthcare Advisory Partners LLC	-	-	-	45	-
WealthTrust Advisors	401	401	-	-	-
Weissborn Asset Management S.A.	7,500	7,500	5,500	5,500	5,500
Weld Capital Management LLC	-	-	-	4,196	-
Wellington Management Company, LLP	333,670	268,665	257,497	104,570	108,096
Wells Fargo Advisors	31,792	32,211	24,034	23,697	20,854
Wells Fargo Bank, N.A.	24,787	23,870	20,605	11,914	26,737
Wells Fargo Investment Institute, Inc.	-	-	-	-	-
Wells Fargo Securities, LLC	4,072	3,822	3,822	2,766	416
Westfield Capital Management Company, L.P.	12,651	12,651	12,651	12,651	370,864
William Blair & Company, L.L.C. (Research)	-	-	-	3,118	4,253
William Blair Investment Management, LLC	-	-	-	981,383	1,281,078
Wilmington Trust Investment Management LLC	620	620	620	620	620
Winton Capital Management Ltd.	33,312	27,973	6,535	5,386	2,980
Wolverine Trading, LLC	3,760	4,334	-	3,162	-
World Asset Management, Inc.	-	1,434	1,308	-	1,128
Wyss & Partner, Vermögensverwaltung und Anlageberatung AG	13,000	9,000	9,000	9,000	9,000
Xact Kapitalforvaltning AB_NLE	9,344	9,344	9,344	9,344	9,344

**Exhibit-5a****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 June 2020</b>	<b>30 September 2020</b>	<b>31 December 2020</b>	<b>31 March 2021</b>	<b>30 June 2021</b>
Xponance, Inc.	3,667	3,772	3,715	3,617	4,564
XTX Markets LLC	-	-	-	-	-
Y-Intercept (Hong Kong) Ltd	-	-	1,955	-	-
Zacks Investment Management, Inc	11,299	-	-	-	-
Zeke Capital Advisors, LLC	-	-	-	-	2,108
Zürcher Kantonalbank (Asset Management)	4,462	4,462	4,773	4,173	3,896

**Source:** Refinitiv Eikon.

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Aberdeen Standard Investments (Edinburgh)	353,865	159,139	-	-
abrdrn Inc.	4,709	4,709	75,863	-
abrdrn Investments Limited	-	-	-	-
Acadian Asset Management LLC	8,802	4,776	7,429	128,726
Adage Capital Management, L.P.	-	-	-	-
Advisors Asset Management, Inc.	337	1,214	1,750	1,674
AGF Investments LLC	-	-	-	-
AHL Partners LLP	20,249	20,282	19,529	22,236
Alaska Retirement Management Board	-	-	-	-
Algert Global LLC	7,244	-	17,298	52,349
AllianceBernstein L.P.	23,969	19,180	18,853	19,181
Allianz Global Investors GmbH	-	-	-	-
Allianz Global Investors U.S. LLC	-	-	-	-
Allied Asset Advisors, Inc.	-	-	14,800	-
Allspring Global Investments, LLC	8,281	615	615	370
Allworth Financial, L.P.	-	-	14	-
Alpha Paradigm Partners, LLC	-	9,212	11,064	-
Alphacrest Capital Management LLC	4,901	5,236	13,904	13,855
AlphaSimplex Group, LLC	3,023	2,034	-	-
Alphastar Capital Management, LLC	-	3,399	3,399	-
Alpine Global Management, LLC	-	5,877	-	-
Altshuler Shaham Ltd.	-	-	-	-
Amalgamated Bank Institutional Asset Management & Custody	7,386	8,582	9,338	9,240
Amalgamated Financial Corp._NLE	-	-	9,338	9,338
American Century Investment Management, Inc.	-	212	212	6,128
American Portfolios Advisors, Inc	74	74	74	74
American Trust Retirement	1,181	1,181	1,181	1,181
Amundi Asset Management, SAS	58	59	59	-
Andbank Wealth Management, SGHC, S.A.U.	-	-	-	-
Aperio Group, LLC	27,526	29,362	37,545	41,452

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
AQR Capital Management, LLC	13,785	23,118	-	54,402
Arizona State Retirement System	11,068	10,962	11,039	11,061
Arkadios Wealth Advisors LLC	100	-	-	-
ArrowMark Colorado Holdings, LLC	-	-	-	-
Arrowstreet Capital, Limited Partnership	-	-	-	5,390
Assenagon Asset Management S.A.	2,614	-	-	-
Asset Management One Co., Ltd.	647	647	720	720
Asset Management One USA Inc.	672	11,341	1,891	1,905
Assetmark, Inc.	04	04	-	-
Associated Investment Management, LLC	-	-	-	-
Atlas Private Wealth Advisors	-	-	-	-
Atom Investors LP	-	2,846	-	-
AtonRa Partners S.A. (Asset Management)	-	-	-	12,440
Avantis Investors	300	300	300	5,207
Avior Wealth Management, LLC	4,973	4,973	4,247	-
Aviva Investors Global Services Limited	-	-	-	-
B. Riley Asset Management, LLC	-	-	30,878	13,600
Bahl & Gaynor, Inc.	-	-	-	-
Balyasny Asset Management LP	-	13,762	-	-
Banco Santander International SA	-	-	-	-
Bank of Nova Scotia	162,396	148,000	100,000	9,000
Bank Vontobel AG	2,439	5,127	3,251	-
Barclays Bank PLC	1,372	11,505	9,127	6,089
Barclays Capital	-	-	58	-
Barclays Capital Inc.	-	82	-	-
Barclays Wealth	1,486	1,420	1,350	1,267
Bares Capital Management, Inc.	4,968,763	4,903,185	5,071,085	5,283,814
Barings LLC	214	214	214	214
Baron Capital Management, Inc.	1,255,130	1,415,130	1,248,209	948,124
Baystate Wealth Management LLC	08	08	08	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
BDO Wealth Advisors, LLC	25	25	-	-
Bell Investment Advisors, Inc.	30	43	43	56
Bellwether Wealth	39	39	-	-
BerganKDV Wealth Management, LLC	-	-	-	-
Berman Capital Advisors, LLC	56	56	56	56
Bessemer Trust Company, N.A. (US)	86,859	86,857	161,857	160,814
BG Fund Management Luxembourg S.A.	-	-	144	648
BI Asset Management Fondsmæglerselskab A/S	-	-	-	-
BlackRock (Netherlands) B.V.	3,382	734	734	734
BlackRock Advisors (UK) Limited	649	655	598	598
BlackRock Asset Management Canada Limited	563	563	563	749
BlackRock Asset Management Ireland Limited	22,849	24,940	25,138	17,521
BlackRock Financial Management, Inc.	84,829	66,575	57,387	64,882
BlackRock Institutional Trust Company, N.A.	1,632,220	1,825,588	1,886,555	2,018,144
BlackRock Investment Management (Australia) Ltd.	403	676	533	879
BlackRock Investment Management (UK) Ltd.	27,827	27,827	30,456	33,297
BlackRock Investment Management, LLC	17,061	17,706	20,099	18,350
BlackRock Japan Co., Ltd.	-	-	-	-
Blue Box Wealth Management SA	174,380	204,180	-	-
Blueshift Asset Management, LLC	1,784	2,644	-	-
BMO Asset Management Inc.	25	25	25	80
BMO Asset Management U.S.	-	-	-	-
BMO Capital Markets (US)	55	58	58	106
BMO Family Office, LLC	848	848	5,020	3,036
BMO Harris Bank N.A.	4,051	4,051	3,861	4,064
BNP Paribas Securities Corp. North America	13,060	63,590	25,696	30,057
BNY Mellon Asset Management	70,751	72,008	114,028	77,221
BNY Mellon Wealth Management	13,883	12,659	12,216	10,334
BofA Global Research (US)	224,512	319,019	233,265	135,534
Bogart Wealth, LLC	10	10	-	-



**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Boothbay Fund Management, LLC	-	-	3,275	13,276
Boston Partners	473	473	-	-
Bridgefront Capital, LLC	-	-	3,934	-
Bridgewater Associates, LP	-	-	-	5,569
Brinker Capital Investments, LLC	-	-	-	-
Brown Advisory	-	-	-	-
Brown Brothers Harriman & Company	20,401	20,401	20,401	20,401
BTC Capital Management, Inc.	-	2,345	2,963	-
Cadian Capital Management LP	-	-	-	197,730
Calamos Advisors LLC	-	-	-	-
California Public Employees' Retirement System	89,894	89,064	89,679	92,061
California State Teachers Retirement System	68,885	56,780	52,380	52,668
Callan LLC	-	-	-	-
Calvert Research and Management	6,479	6,745	7,494	-
Cambridge Investment Research Advisors, Inc.	2,050	1,870	-	-
Cambridge Trust Company	5,000	5,000	5,000	5,000
Campbell & Company, Inc.	-	-	7,325	11,790
Capital Advisors, Ltd., LLC	-	-	05	28
Capital International, Inc.	4,020	5,045	7,903	-
Capital Research Global Investors	934,095	977,966	2,142,547	3,368,051
Capstone Triton Financial Group, LLC	-	-	-	-
CAPTRUST Financial Advisors	619	632	1,326	3,321
Capula Investment Management LLP	-	-	-	-
Carne Global Fund Managers (Ireland) Limited	4,429	4,776	4,776	4,776
Carolinas Wealth Consulting LLC	-	-	-	-
Carroll Financial Associates, Inc.	1,607	205	205	205
Carson Wealth Management Group	-	30	270	301
CastleArk Management, LLC	-	-	-	-
Cathay Securities Investment Trust Co., Ltd.	4,911	5,699	6,757	10,377
CenterBook Partners LP	-	11,354	17,686	27,872

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Centiva Capital, LP	-	-	-	-
Central Trust & Investment Company	238	238	235	235
Cetera Advisor Networks LLC	-	-	-	-
CG Advisory Services	-	-	-	-
Charles Schwab Investment Management, Inc.	216,258	225,032	237,502	254,127
Checchi Capital Advisers, LLC	-	-	-	-
CI Global Asset Management	60	173	142	105
CIBC Asset Management Inc.	3,148	3,270	3,270	-
Circle Wealth Management, LLC	-	-	-	-
Citadel Advisors LLC	-	68,650	194,125	14,020
Citi Investment Research (US)	17,616	19,614	19,361	16,586
City National Rochdale, LLC	325	354	289	70
ClearArc Capital, Inc._NLE	-	-	-	-
Clearline Capital LP	-	-	-	21,002
Columbia Threadneedle Investments (US)	7,312	1,892	-	-
Column Capital Advisors, LLC	77	77	77	77
Comerica, Inc.	62,420	63,440	64,440	-
Commonwealth Financial Network	14,018	12,083	11,133	8,678
Concord Wealth Partners	38	38	62	38
Connor, Clark & Lunn Investment Management Ltd.	-	-	-	34,585
Corbenic Partners, LLC_NLE	114	114	-	-
Cornerstone Advisors, Inc. (WA)	34	34	34	34
Cornerstone Advisory, LLC	-	45	-	-
Covestor, Ltd.	-	527	98	97
CPP Investment Board	16,000	16,000	-	-
Crawford Investment Counsel, Inc.	91,018	98,238	176,776	101,100
Creative Planning, Inc.	-	-	-	-
Credit Suisse Funds AG	42,371	42,534	47,589	45,294
Credit Suisse International	50	93	94	91
Credit Suisse Securities (Europe) Limited	-	-	-	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Credit Suisse Securities (USA) LLC	5,528	12	339	492
Cresset Asset Management, LLC	2,510	-	-	-
Crestline Investors, Inc.	-	-	-	-
Cubist Systematic Strategies, LLC	1,674	21,674	77,143	102,160
Curi Capital	-	02	02	02
Cutler Group, LP	-	3,800	1,800	1,700
CVA Family Office, LLC	-	-	-	-
D. E. Shaw & Co., L.P.	-	13,650	66,070	173,691
Danske Bank Asset Management	3,248	4,448	5,048	5,148
Danske Bank Oyj	900	900	900	900
Dara Capital US, Inc.	216	-	-	-
Dark Forest Capital Management LP	-	43	-	14
DBX Advisors LLC.	-	-	-	-
DeepCurrents Investment Group LLC	-	-	-	-
Deutsche Asset Management Americas	444,933	441,049	371,049	206,999
Dimensional Fund Advisors Canada ULC	100	100	100	100
Dimensional Fund Advisors, L.P.	202,987	206,050	203,979	72,010
Dimensional Fund Advisors, Ltd.	18,099	19,540	24,293	2,110
Diversified Trust Company	2,353	-	-	6,308
Dorsal Capital Management, LLC	-	-	-	-
Duality Group	-	6,066	-	53,584
Dubuque Bank and Trust Company	2,270	-	-	-
DWS Investment GmbH	16,583	16,043	15,795	1,680
DWS Investment Management Americas, Inc.	-	-	-	-
DWS Investments UK Limited	559	-	-	-
Dynamic Technology Lab Pte. Ltd.	-	-	6,620	5,694
E*TRADE Capital Management LLC	-	-	-	-
Eagle Asset Management, Inc.	589,315	540,279	441,288	-
Eagle Bay Advisors LLC	12	06	-	-
EAM Investors, LLC	-	-	-	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Eaton Vance Management	508	508	9,029	-
Elequin Capital, L.P.	-	-	94	54
Elkfork Partners LLC	-	-	-	-
Ellevest, Inc.	85	334	146	820
Emerald Advisers LLC	4,487	4,415	-	-
Eminence Capital, LP	1,123,718	1,148,328	879,740	1,237,926
Engineers Gate Manager, L.P.	-	2,458	71,571	110,505
Engle Capital Management, L.P.	-	-	-	-
Ensign Peak Advisors, Inc.	370,747	349,315	4,770	6,010
Enterprise Financial Services Corp.	-	-	-	-
Envestnet Asset Management, Inc.	65,968	68,229	69,574	67,528
Equis Capital Management, Inc.	-	-	3,901	-
Ergoteles Capital	-	-	5,813	22,370
ETF Managers Group, LLC	-	-	-	13,304
Ethical Capital Opportunity Advisors Ltd	-	-	-	23,730
Eurizon Capital S.A.	-	-	-	-
Evelyn Partners Investment Management LLP	-	-	-	-
EverSource Wealth Advisors, LLC	-	122	122	-
Evolve Funds Group Inc	829	936	-	-
EVR Research LP	-	-	77,000	-
Exchange Traded Concepts, LLC	-	-	-	-
ExodusPoint Capital Management, LP	20,738	-	27,094	30,189
Exponential ETFs	-	-	-	-
FDX Advisors, Inc.	12,455	6,681	10,200	8,977
Federated Hermes Investment Management Company	-	-	-	5,426
Federated MDTA LLC	26,974	26,974	26,974	427,284
Fidelity Institutional Asset Management	8,208	2,208	60,774	1,351
Fidelity International	3,500	22,856	158,405	311,052
Fidelity Investments Canada ULC	13,648	-	-	-
Fidelity Management & Research Company LLC	69,318	97	802	865

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Fiera Capital Corporation	-	-	-	-
FIL Investment Management (Australia) Limited	-	-	-	-
FinTrust Capital Advisors, LLC	-	-	-	-
First Horizon Advisors, Inc.	474	474	-	474
First Trust Advisors L.P.	189,564	64,051	61,273	83,909
Fisher Investments	689,953	722,455	724,432	769,669
Flagship Harbor Advisors LLC	-	-	-	-
Florida State Board of Administration	51,228	51,488	50,948	49,541
Fora Capital LLC	-	-	3,637	5,419
Fortis Capital Management, L.L.C.	11,256	-	-	-
Founders Financial Alliance, LLC	-	-	-	-
Foxhaven Asset Management, LP	1,347,696	1,427,203	-	-
Fred Alger Management, LLC	-	-	-	-
Frontier Capital Management Company, LLC	58,418	57,610	-	-
Fulcrum Asset Management LLP	2,406	2,406	5,521	5,521
GAM International Management Ltd.	197,822	197,822	189,894	127,816
Geneos Wealth Management Inc	-	-	07	-
Geode Capital Management, L.L.C.	539,797	554,628	581,603	575,437
George Kaiser Family Foundation	67,079	67,047	73,447	29,909
Glassman Wealth Services LLC	20	-	86	111
Glen Harbor Capital Management LLC_NLE	-	-	-	-
GLG Partners LP	-	1,794	441	-
Global Beta Advisors LLC	-	-	-	114
Global X Management (AUS) Limited	35,774	-	-	-
Goldman Sachs & Company, Inc.	410,597	296,267	323,299	174,612
Goldman Sachs Advisors B.V.	900	-	-	-
Goldman Sachs Asset Management B.V.	900	900	-	-
Goldman Sachs Asset Management, L.P.	70,902	57,064	75,884	74,956
Gotham Asset Management, LLC	4,381	-	-	29,643
Graham Capital Management, L.P.	-	-	10,604	11,209

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Graham Partners LP	-	-	161,629	333,596
Graubündner Kantonalbank	-	-	-	-
Greenwood Capital Associates, LLC	7,509	7,481	7,105	7,105
Group One Trading, L.P.	-	9,037	6,813	-
GSA Capital Partners LLP	6,270	6,682	5,249	7,834
Guggenheim Investments	-	4,130	5,388	9,951
Guinness Atkinson Asset Management Inc.	660	660	660	790
GW&K Investment Management, LLC	-	-	-	-
GWL Investment Management Ltd.	111,624	116,140	123,654	123,409
Gyon Technologies Capital Management, LP	-	3,477	-	5,662
H. M. Payson & Co.	50	50	50	50
Handelsbanken Kapitalförvaltning AB	7,444	7,444	5,144	6,144
Hardy Reed, LLC	2,184	2,184	-	-
Harvest Fund Management Co., Ltd.	-	-	-	-
Hawk Ridge Capital Management LP	-	-	110,700	-
HC Financial Advisors, Inc.	150	150	150	-
Hennion & Walsh Asset Management, Inc.	-	2,569	2,815	-
Herald Investment Management Limited	319,000	319,000	326,500	326,500
Highside Global Management LLC	-	-	125,863	218,760
Highstreet Asset Management Inc.	14	-	-	-
Hightower Advisors, LLC	8,582	44,422	10,853	10,244
Holocene Advisors, LP	3,529	32,808	24,478	91,553
HOOPP Investment Management	-	-	13,133	-
Horizons ETFs Management (Canada) Inc.	-	-	-	12,306
HRT Financial LP	-	3,912	-	-
HSBC Global Asset Management (UK) Limited	4,799	5,827	16,699	-
Huntington Private Financial Group	149	149	01	329
Icon Wealth Partners, LLC	12,426	6,652	11,074	8,977
ID-Sparinvest A/S	2,091	2,091	2,091	2,091
IFAM Capital	15	15	14	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Illinois Municipal Retirement Fund	9,531	12,683	12,683	21,793
Independent Advisor Alliance, LLC	2,887	2,794	2,507	-
Independent Financial Partners	-	-	15	15
ING Bank N.V.	10,000	-	-	-
Innealta Capital, LLC	07	07	07	05
Insight Advisors, LLC	2,816	2,816	2,816	-
Inspire Investing	1,760	2,201	2,925	4,436
Interchange Capital Partners LLC	-	-	-	-
International Assets Investment Management, LLC	-	-	-	-
Invesco Advisers, Inc.	1,819,513	859,568	223,908	25,903
INVESCO Asset Management Deutschland GmbH	231	231	231	231
Invesco Capital Management LLC	66,585	7,868	12,821	17,233
Irish Life Investment Managers Ltd.	112,332	116,848	121,494	121,249
Ironwood Investment Management, LLC	46,602	46,734	47,387	47,402
J.P. Morgan Investment Management, Inc. (SI)	18,393	18,537	19,901	20,430
J.P. Morgan Private Wealth Advisors LLC	1,634	1,567	996	874
J.P. Morgan Securities LLC	218	218	12,590	30,491
J.P. Morgan Securities plc	-	-	-	33,282
Jacobs Levy Equity Management, Inc.	-	-	58,441	49,411
Jane Street Capital, L.L.C.	-	137,841	12,204	141,578
Janus Henderson Investors	4,278	8,216	28,854	8,443
Jefferies LLC	5,700	-	-	-
Jennison Associates LLC	-	-	-	-
JFS Wealth Advisors, LLC	-	07	-	-
JP Morgan Alternative Asset Management, Inc.	-	-	-	-
JP Morgan Asset Management	21,463	20,397	20,674	21,214
JPMorgan Asset Management U.K. Limited	2,889	1,683	-	-
JPMorgan Private Bank (United States)	7,953	3,103	5,651	5,950
JT Stratford LLC	2,568	2,656	-	-
Jump Financial, LLC	-	-	-	33,300

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Jupiter Asset Management Ltd.	-	-	-	-
Jupiter Wealth Management, LLC	3,000	-	-	-
Kaydan Wealth Management, Inc.	-	1,805	-	-
KB Asset Management Co., Ltd.	-	-	-	-
KBC Group NV	-	-	-	528
Kentucky Teachers' Retirement System	-	-	-	-
KeyBanc Capital Markets	-	-	19,008	-
KLP Fondsforvaltning AS	6,500	6,400	7,100	7,100
Knowledge Leaders Capital, LLC	6,216	-	-	-
L. Roy Papp & Associates, LLP	26,760	26,760	25,910	25,910
L2 Asset Management, LLC	34	52	52	69
Ladenburg Thalmann Asset Management Inc. (LTAM)	460	-	-	-
Landsberg, Bennett, & Dubbanh LLC	29,152	29,152	29,152	29,152
Lazard Asset Management, L.L.C.	330,728	323,846	310,023	-
Lee Capital Asset Management LLC	24,570	-	-	-
Lee Capital Holdings LLC	-	-	18,675	-
Legal & General Investment Management Ltd.	74,597	73,341	71,655	70,461
Lenox Wealth Advisors, LLC	-	-	-	-
Lindbrook Capital, LLC	33	1,505	979	30
Liontrust Investment Partners LLP	52,600	18,000	9,000	9,000
Lloyds Bank International Limited	-	-	-	-
Locust Wood Capital Advisers, LLC	372,324	401,787	-	-
Loomis, Sayles & Company, L.P.	224,171	221,901	-	-
Los Angeles Capital Management LLC	6,419	5,037	4,957	4,717
LPL Financial LLC	7,915	6,975	6,563	-
LSV Asset Management	1,341	500	-	-
Luxor Capital Group, L.P.	3,200,787	4,507,157	4,430,983	4,059,386
M Capital Advisors	13,476	13,421	12,468	-
Macquarie Investment Management	292	-	-	1,375
Macquarie Investment Management Global Ltd.	1,556	1,375	1,375	-



**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Madison Avenue Partners LP	-	-	-	277,821
Magnetar Capital Partners LP	-	-	-	-
MainStreet Advisors	1,129	1,129	1,126	1,118
Makena Capital Management, LLC	-	-	-	-
Malaga Cove Capital, LLC	10,926	10,167	11,643	13,034
Managed Account Advisors LLC	135,031	125,612	130,756	80,117
Manchester Capital Management LLC	293	293	148	148
Manulife Investment Management (North America) Limited	1,661	-	-	-
Marshall Wace LLP	-	-	-	91,392
Martingale Asset Management, L.P.	-	-	-	-
Maryland Capital Management, LLC_NLE	3,986	4,356	4,046	-
Maryland State Retirement & Pension System	3,147	3,147	3,147	-
Maverick Capital, Ltd.	2,867	-	-	-
McIlrath & Eck, LLC	175	175	175	-
Meadow Creek Investment Management LLC	-	-	-	-
Mellon Investments Corporation	70,237	79,335	94,263	100,749
Melqart Asset Management (UK) Limited	-	-	-	-
Mercer Global Investments Management Ltd	43,550	34,387	35,362	9,955
Meridian Wealth Partners, L.L.C.	-	-	-	-
MetLife Investment Management, LLC	-	-	2,536	2,562
METROPOLE Gestion	473	473	473	473
Metropolitan Life Insurance Co. (US)	2,626	2,606	-	-
MFS Investment Management	300	277	277	-
MGO One Seven LLC	3,415	3,686	3,601	-
Mid-Continent Capital, LLC	45	45	-	-
Millennium Management LLC	46,956	-	310,275	568,214
Mirae Asset Global Investments (USA) LLC	13,155	14,309	15,348	31,973
Missouri Trust & Investment Company	-	52	52	52
MML Investors Services, LLC	1,868	2,175	-	-
Mont Blanc Capital Management AG	400	-	-	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Morgan Stanley & Co. International Plc	-	01	-	150
Morgan Stanley & Co. LLC	17,463	18,684	386,320	86,712
Morgan Stanley Investment Management Inc. (US)	3,149	3,115	3,269	3,203
Morgan Stanley Smith Barney LLC	7,604	6,362	7,023	6,308
Motley Fool Asset Management, LLC	-	38	-	-
MUFG Securities EMEA plc	-	-	-	-
National Bank of Canada	-	129	129	-
National Bank Trust	22	22	129	-
Natixis Investment Managers SA	-	-	-	-
NBC Capital Advisors	-	-	-	-
Neiman Funds Management LLC	1,200	1,200	1,200	1,200
Neuberger Berman Asset Management Ireland Ltd	11,800	11,800	11,800	11,800
New Jersey Division of Investment	21,281	23,417	31,725	46,859
New York State Common Retirement Fund	46,692	46,700	46,854	45,388
Newton Investment Management North America, LLC	-	-	8,318	8,318
NEXT Financial Group, Inc.	09	09	09	09
NNIP Asset Management B.V. _NLE	900	-	-	-
Nomura Securities Co., Ltd.	-	12,962	-	-
Norges Bank Investment Management (NBIM)	395,328	399,236	383,167	383,772
North Run Capital, LP	55,000	52,800	38,300	17,570
Northern Trust Global Investments	133,475	127,668	129,756	109,014
Northern Trust Global Investments Limited	13,545	13,033	13,447	14,005
Northern Trust Investments, Inc.	184,769	180,742	171,329	170,641
Northwestern Mutual Capital, LLC	637	829	1,175	1,300
Numeric Investors LLC	-	-	11,500	6,100
Nuveen Asset Management, LLC	-	592	592	592
Nuveen LLC	187,711	164,477	161,551	82,337
Nykredit Bank AS	901	901	360	360
Oak Thistle LLC	-	-	7,310	-
Ofi Asset Management _NLE	5,372	5,372	5,372	5,372

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
OFI Invest Asset Management	5,372	5,372	5,372	5,372
Ohio Public Employees Retirement System	23,133	22,439	21,687	21,209
Oppenheimer Asset Management Inc.	50,513	49,473	48,279	45,407
Osaic Holdings, Inc.	5,205	5,767	6,059	5,274
O'Shaughnessy Asset Management, LLC	142	-	-	-
Ostrum Asset Management	38,605	52,710	12,600	30,784
Outfitter Financial LLC	-	200	-	-
Pacifica Partners Inc.	-	-	-	-
Paloma Partners Management Company	-	-	-	-
PanAgora Asset Management Inc.	-	-	-	-
Paragon Wealth Strategies, LLC	-	-	-	-
Parallax Volatility Advisers, L.P.	-	2,369	-	-
Parallel Advisors, LLC	473	723	660	620
Parametric Portfolio Associates LLC	33,280	34,170	96,188	133,847
Parkside Financial Bank & Trust	1,587	1,616	1,748	1,725
PDT Partners, LLC	-	-	-	-
Peak 6 Capital Management, LLC	-	10,072	-	6,667
Penserra Capital Management LLC	17,356	21,475	21,432	25,080
Personal Capital Advisors Corporation	2,493	2,492	2,492	-
PFS Partners, LLC	-	200	200	200
PGIM Fixed Income	1,885	1,885	1,885	1,885
PGIM Investments LLC	-	-	-	21,100
PGIM Quantitative Solutions LLC	1,333	1,233	1,233	37,033
Pictet Asset Management Ltd.	2,929	2,929	2,929	-
PIMCO (US)	-	-	-	-
Ping An of China Asset Management (Hong Kong) Co., Ltd.	1,066	1,238	1,365	1,992
Pinnacle Financial Partners, Inc.	-	-	-	-
Pinnacle Wealth Planning Services, Inc.	-	-	-	-
PNC Investments LLC	9,295	9,906	8,963	8,798
Point72 Asset Management, L.P.	85,661	35,561	32,961	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Point72 Hong Kong Limited	2,237	463	-	-
Praesidium Investment Management Company, LLC	1,590,642	1,495,314	1,608,263	650,440
Princeton Capital Management LLC	4,000	4,000	4,000	-
Principal Global Investors (Equity)	4,157	4,369	4,038	5,535
Private Advisor Group LLC	-	-	-	-
Private Capital Group, LLC	244	244	244	244
Procyon Advisors, LLC	-	-	-	-
ProEquities Inc	867	782	395	2,787
ProFund Advisors LLC	384	386	299	282
ProShare Advisors LLC	2,133	2,939	-	-
Provenire Capital, LLC	-	-	-	-
Prudential Financial Planning Services,	2,227	2,251	2,636	1,461
Psagot Mutual Funds Ltd	2,081	-	-	-
PSP Investments	-	-	-	-
Public Employees' Retirement Association of CO	6,018	6,018	6,018	6,018
Quadrant Family Wealth Advisors	46	04	88	696
Quadrature Capital LLP	-	-	-	8,250
Quantbot Technologies, LP	1,858	1,258	-	-
Quantitative Investment Management LLC	-	-	-	-
Qube Research & Technologies Ltd	-	-	110,210	86,675
Quent Capital, LLC	-	4,440	4,440	4,480
Rafferty Asset Management LLC	-	89	112	50
RAM Active Investments S.A.	-	-	-	1,200
Ranger Investment Management, L.P.	419,354	449,071	460,991	452,581
Rational Advisors, Inc.	-	-	-	-
Raymond James & Associates, Inc.	16,211	15,189	15,070	-
Raymond James Financial Services Advisors, Inc.	1,657	-	13,063	-
RBC Brewin Dolphin	155	155	-	-
RBC Capital Markets Wealth Management	15,067	15,021	16,758	17,504
RBC Capital Partners	-	-	-	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
RBC Dominion Securities, Inc.	74	50	-	1,526
RBC Wealth Management, International	280,139	276,859	223,760	124,872
Redwood Investments, LLC	-	-	-	-
Regent Peak Wealth Advisors, LLC	-	-	-	-
Renaissance Technologies LLC	-	-	158,324	398,424
Repertoire Partners LP	-	-	25,000	100
Research Affiliates, LLC	-	-	-	-
Resolute Financial LLC	-	3,987	3,987	-
Reynolds Capital Management, LLC	-	400	-	900
Rhumblin Advisers Ltd. Partnership	38,421	39,576	37,267	41,737
Rice Hall James & Associates, LLC	47,900	47,592	47,160	-
Richard Bernstein Advisors LLC	-	-	-	-
Rise Advisors, LLC	-	75	75	75
Riverbridge Partners, LLC	1,363,141	1,411,386	1,494,937	1,300,901
Riverview Trust Co	-	-	-	326
Rockefeller Capital Management	-	543	542	313
Ropes Wealth Advisors LLC	-	-	-	-
Roubaix Capital, LLC	-	-	25,170	-
Russell Investments Limited	5,862	6,429	7,412	8,312
Russell Investments Trust Company	98,318	113,275	99,773	79,724
S.B. Carr Investments, Inc.	-	-	-	-
Sageworth Trust Co of South Dakota	-	1,095	1,095	199
Sageworth Trust Co.	1,430	330	330	330
Samsung Asset Management Co., Ltd.	123	123	123	123
Scholtz & Company, LLC	11,977	-	-	-
Schonfeld Strategic Advisors LLC	-	-	-	-
Schubert & Co	-	01	-	-
Schweizerische Nationalbank	89,700	89,600	96,500	96,500
Sciencast Management LP	-	-	4,281	-
Scout Investments, Inc.	-	-	-	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Segall Bryant & Hamill, LLC	114,547	114,741	117,387	52,822
SEI Investments Management Corporation	30,323	30,599	31,959	65,926
Seven Eight Capital, LP	-	-	6,541	-
SG Americas Securities, L.L.C.	26,362	6,937	5,977	3,141
Shannon River Fund Management LLC	134,411	-	406,289	113,124
Sierra Capital LLC	-	24	24	-
Signaturefd, LLC	533	603	737	799
Simplex Trading, LLC	1,902	7,881	5,635	12,896
SinoPac Securities Investment Trust Co., Ltd.	111	128	141	141
Snowden Capital Advisors LLC	-	1,256	-	-
Sound Income Strategies, LLC	-	-	-	-
Southpoint Capital Advisors LP	1,100,000	1,000,000	800,000	-
Sowell Management Services	-	-	-	-
Sparkline Capital LP	41	-	104	-
Spire Wealth Management, LLC	1,049	1,049	1,049	549
SQN Investors LP	-	-	-	-
Squarepoint Capital LLP	-	-	-	-
SRS Capital Advisors, Inc	-	11	34	11
Standard Family Office LLC	-	-	-	-
State of Wisconsin Investment Board	5,114	4,959	36,808	44,250
State of Wyoming	1,637	1,458	1,245	870
State Street Global Advisors (UK) Ltd.	-	-	-	-
State Street Global Advisors (US)	608,224	609,989	632,675	641,215
State Street Global Advisors Ireland Limited	3,884	3,510	3,616	3,112
State Teachers Retirement System of Ohio	-	-	-	-
Stephens Capital Management	-	-	-	-
Steward Partners Investment Advisory, LLC	300	300	500	519
Stone Ridge Asset Management LLC	2,443	2,443	2,443	-
Stonebridge Capital Advisors, LLC	12	12	-	-
Sturgeon Ventures LLP	40,221	19,221	-	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Sumitomo Mitsui Trust Asset Management Co., Ltd.	300	300	700	700
Sumitomo Mitsui Trust Bank, Limited	-	-	-	-
SunAmerica Asset Management, LLC	781	756	755	645
Susquehanna Fundamental Investments, LLC	-	-	-	-
Susquehanna International Group, LLP	-	20,658	19,754	13,231
Synovus Trust Company, N.A.	8,320	8,851	10,354	-
T. Rowe Price Associates, Inc.	348,203	260,919	192,046	35,712
TCI Wealth Advisors, Inc.	117	117	119	117
Teacher Retirement System of Texas	6,516	7,904	8,337	6,358
Thames Capital Management	29,283	-	-	-
The Colony Group, LLC	-	-	-	-
The Commerce Trust Company	35,570	37,806	49,225	7,548
The Connable Office, Inc.	2,905	2,905	2,905	-
The Harvest Group Wealth Management, LLC	-	-	-	-
The MassMutual Trust Company, FSB	-	-	23	-
The Treasurer of the State of North Carolina	14,694	14,784	15,022	17,489
The Vanguard Group, Inc.	3,781,379	3,745,052	3,733,945	4,136,672
Tinkoff Capital OOO	-	785	785	785
Tiverton Asset Management LLC_NLE	-	-	-	-
TOBAM	495	495	-	-
Toroso Asset Management	890	1,056	1,217	1,032
Total Clarity Wealth Management, Inc.	100	100	-	70
Totem Point Management, LLC	-	-	-	67,101
Tower Research Capital LLC	3,485	2,748	939	291
TPG Capital, L.P.	1,227,701	1,490,120	1,968,657	2,442,279
Trellus Management Company, LLC	4,500	-	-	-
Trexquant Investment LP	2,100	4,496	27,866	52,404
TrinityPoint Wealth LLC	2,017	2,110	-	-
TruClarity Wealth Advisors	-	-	20	-
Trustcore Financial Services, LLC	-	-	-	-

**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Tudor Investment Corporation	3,280	34,588	66,837	84,754
Tuttle Capital Management, LLC	-	-	-	-
Twin Tree Management, LP	-	23,503	31,653	-
TwinBeech Capital LP	-	4,940	24,694	-
Two Sigma Investments, LP	-	-	54,733	-
Tyers Asset Management LLC	-	-	-	-
Tygh Capital Management, Inc. _NLE	-	-	-	-
U.S. Bancorp Asset Management, Inc.	17,984	17,088	15,726	15,566
UBS Asset Management (Americas), Inc.	19,511	19,511	21,933	23,590
UBS Asset Management (Switzerland)	23,048	23,048	23,048	23,048
UBS Asset Management (UK) Ltd.	17,184	15,595	15,791	15,406
UBS Financial Services, Inc.	27,382	18,867	13,716	8,234
UMB Bank, NA	-	53	53	53
Union Bank & Trust Company (Nebraska)	05	-	-	-
University of Notre Dame du Lac	9,013	-	-	-
Utah Retirement Systems	7,399	7,399	7,199	7,199
Valeo Financial Advisors LLC	-	-	-	-
Value Partners Investments, Inc.	-	2,000	-	-
Vanguard Global Advisers LLC	410	576	593	761
Vanguard Investments Australia Ltd.	10,808	6,497	8,046	8,046
Vanguard Personalized Indexing Management, LLC	2,028	-	-	4,268
Vantage Consulting Group, Inc.	-	-	-	-
Vaughan Nelson Investment Management, L.P.	74	74	74	-
Venturi Private Wealth	-	-	-	-
Veritas Asset Management LLP	-	-	-	-
Verition Fund Management LLC	15,254	-	16,808	6,816
Victory Capital Management Inc.	26,097	30,129	5,197	5,174
Virginia Retirement System	2,800	4,400	8,700	8,700
Virtu Americas LLC	-	3,200	-	-
Virtus Alternative Investment Advisers, Inc.	47	47	47	47



**Exhibit-5b****Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Virtus Investment Advisers, Inc.	1,998	1,998	1,998	-
Voloridge Investment Management, LLC	-	32,067	37,791	148,320
Voya Investment Management LLC	12,529	19,385	19,015	17,564
Walleye Capital LLC	-	-	5,083	-
Walleye Trading, LLC	-	12,098	-	54,337
Washington Capital Management, Inc.	-	-	4,500	-
Washington Harbour Partners L.P.	46,075	-	-	-
Wealthcare Advisory Partners LLC	-	-	-	-
WealthTrust Advisors	-	-	-	-
Weissborn Asset Management S.A.	5,500	5,500	5,500	-
Weld Capital Management LLC	-	-	-	-
Wellington Management Company, LLP	123,575	133,966	136,657	147,666
Wells Fargo Advisors	19,980	20,264	19,703	3,957
Wells Fargo Bank, N.A.	14,459	6,316	5,762	2,174
Wells Fargo Investment Institute, Inc.	-	2,422	1,844	1,468
Wells Fargo Securities, LLC	1,866	1,866	-	-
Westfield Capital Management Company, L.P.	443,730	392,250	402,385	-
William Blair & Company, L.L.C. (Research)	4,080	4,137	-	-
William Blair Investment Management, LLC	1,264,248	1,189,235	-	-
Wilmington Trust Investment Management LLC	620	620	620	620
Winton Capital Management Ltd.	4,738	2,404	-	-
Wolverine Trading, LLC	-	5,001	-	-
World Asset Management, Inc.	-	-	-	-
Wyss & Partner, Vermögensverwaltung und Anlageberatung AG	9,000	9,000	9,000	9,000
Xact Kapitalforvaltning AB_NLE	9,344	9,344	-	-
Xponance, Inc.	4,415	4,446	4,502	4,866
XTX Markets LLC	-	2,596	-	-
Y-Intercept (Hong Kong) Ltd	-	-	2,614	9,016
Zacks Investment Management, Inc.	-	-	-	32,779
Zeke Capital Advisors, LLC	2,446	2,446	3,059	-

**Exhibit-5b**

**Institutional Holdings of Pegasystems Common Stock During the Examination Period**

	<b>30 September 2021</b>	<b>31 December 2021</b>	<b>31 March 2022</b>	<b>30 June 2022</b>
Zürcher Kantonalbank (Asset Management)	3,896	5,295	6,008	4,469

**Source:** Refinitiv Eikon.

**Exhibit-6****Pegasystems Common Stock Short Interest**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>Short Interest</b>	<b>Shares Outstanding</b>	<b>Short Interest as Percent of Shares Outstanding</b>
6/15/2020	1,935,588	80,089,203	2.42%
6/30/2020	1,867,341	80,089,203	2.33%
7/15/2020	1,705,301	80,415,254	2.12%
7/31/2020	1,656,807	80,415,254	2.06%
8/14/2020	1,620,508	80,415,254	2.02%
8/31/2020	1,626,067	80,415,254	2.02%
9/15/2020	1,725,679	80,415,254	2.15%
9/30/2020	1,691,175	80,415,254	2.10%
10/15/2020	1,718,384	80,415,254	2.14%
10/30/2020	1,914,419	80,697,696	2.37%
11/13/2020	1,924,073	80,697,696	2.38%
11/30/2020	1,994,049	80,697,696	2.47%
12/15/2020	1,991,181	80,697,696	2.47%
12/31/2020	2,009,626	80,697,696	2.49%
1/15/2021	1,862,429	80,697,696	2.31%
1/29/2021	1,896,379	80,697,696	2.35%
2/12/2021	2,298,392	80,900,637	2.84%
2/26/2021	2,075,785	80,900,637	2.57%
3/15/2021	1,720,978	80,900,637	2.13%
3/31/2021	1,677,232	80,900,637	2.07%
4/15/2021	1,764,075	80,900,637	2.18%
4/30/2021	2,433,900	81,281,726	2.99%
5/14/2021	2,309,194	81,281,726	2.84%
5/28/2021	1,832,865	81,281,726	2.25%
6/15/2021	2,199,955	81,281,726	2.71%
6/30/2021	1,829,697	81,281,726	2.25%
7/15/2021	1,474,989	81,281,726	1.81%
7/30/2021	1,610,721	81,455,672	1.98%
8/13/2021	1,621,055	81,455,672	1.99%
8/31/2021	1,688,651	81,455,672	2.07%
9/15/2021	1,697,057	81,455,672	2.08%
9/30/2021	1,620,122	81,455,672	1.99%
10/15/2021	1,504,727	81,455,672	1.85%
10/29/2021	1,599,257	81,675,315	1.96%
11/15/2021	1,609,813	81,675,315	1.97%
11/30/2021	1,716,552	81,675,315	2.10%
12/15/2021	1,615,144	81,675,315	1.98%

**Exhibit-6****Pegasystems Common Stock Short Interest**

15 June 2020 through 15 September 2022

<b>Date</b>	<b>Short Interest</b>	<b>Shares Outstanding</b>	<b>Short Interest as Percent of Shares Outstanding</b>
12/31/2021	1,924,077	81,675,315	2.36%
1/14/2022	1,912,213	81,675,315	2.34%
1/31/2022	2,412,805	81,675,315	2.95%
2/15/2022	2,127,940	81,631,845	2.61%
2/28/2022	1,738,883	81,631,845	2.13%
3/15/2022	1,677,132	81,631,845	2.05%
3/31/2022	1,520,931	81,631,845	1.86%
4/14/2022	1,482,770	81,631,845	1.82%
4/29/2022	1,391,263	81,818,454	1.70%
5/13/2022	1,622,032	81,818,454	1.98%
5/31/2022	1,501,158	81,818,454	1.83%
6/15/2022	1,326,256	81,818,454	1.62%
6/30/2022	1,259,495	81,818,454	1.54%
7/15/2022	1,333,199	81,818,454	1.63%
7/29/2022	1,300,790	81,952,276	1.59%
8/15/2022	1,728,353	81,952,276	2.11%
8/31/2022	1,956,093	81,952,276	2.39%
9/15/2022	1,848,327	81,952,276	2.26%

**Sources:** Bloomberg (Short Interest), Company SEC Filings (Shares Outstanding), and computations performed by Crowninshield Financial Research, Inc.

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
6/16/2020	1.75%	1.97%
6/17/2020	-0.41%	-0.34%
6/18/2020	0.12%	1.51%
6/19/2020	-0.46%	-0.13%
6/22/2020	0.67%	2.10%
6/23/2020	0.39%	-0.18%
6/24/2020	-2.61%	-2.18%
6/25/2020	1.12%	1.36%
6/26/2020	-2.31%	-0.82%
6/29/2020	1.44%	-0.22%
6/30/2020	1.46%	2.05%
7/1/2020	0.40%	1.67%
7/2/2020	0.50%	0.33%
7/6/2020	1.48%	1.06%
7/7/2020	-1.03%	-0.78%
7/8/2020	0.84%	2.10%
7/9/2020	-0.57%	0.80%
7/10/2020	1.03%	-0.65%
7/13/2020	-1.13%	-4.49%
7/14/2020	1.32%	0.44%
7/15/2020	1.17%	0.18%
7/16/2020	-0.40%	-1.32%
7/17/2020	0.36%	1.00%
7/20/2020	0.85%	3.80%
7/21/2020	0.23%	-1.19%
7/22/2020	0.51%	0.40%
7/23/2020	-1.10%	-2.07%
7/24/2020	-0.70%	-1.14%
7/27/2020	0.90%	1.62%
7/28/2020	-0.69%	-0.84%
7/29/2020	1.33%	2.05%
7/30/2020	-0.38%	-0.17%
7/31/2020	0.45%	0.73%
8/3/2020	0.87%	2.01%
8/4/2020	0.45%	-0.37%
8/5/2020	0.75%	0.58%
8/6/2020	0.46%	0.24%
8/7/2020	0.02%	-2.32%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
8/10/2020	0.26%	-1.58%
8/11/2020	-0.80%	-1.72%
8/12/2020	1.29%	0.97%
8/13/2020	-0.06%	1.51%
8/14/2020	-0.07%	-0.51%
8/17/2020	0.50%	1.22%
8/18/2020	0.14%	1.16%
8/19/2020	-0.44%	-0.02%
8/20/2020	0.28%	2.02%
8/21/2020	0.16%	-0.71%
8/24/2020	0.89%	0.47%
8/25/2020	0.34%	1.03%
8/26/2020	0.87%	5.43%
8/27/2020	0.17%	-0.44%
8/28/2020	0.69%	1.09%
8/31/2020	-0.16%	-0.21%
9/1/2020	0.85%	2.93%
9/2/2020	1.20%	0.51%
9/3/2020	-3.46%	-5.78%
9/4/2020	-0.81%	-3.19%
9/8/2020	-2.72%	-3.55%
9/9/2020	1.96%	2.79%
9/10/2020	-1.57%	-1.26%
9/11/2020	-0.02%	-1.44%
9/14/2020	1.53%	1.88%
9/15/2020	0.54%	1.68%
9/16/2020	-0.32%	-1.56%
9/17/2020	-0.79%	-1.32%
9/18/2020	-0.89%	-0.56%
9/21/2020	-1.26%	1.83%
9/22/2020	0.93%	1.93%
9/23/2020	-2.43%	-2.73%
9/24/2020	0.20%	-0.46%
9/25/2020	1.56%	2.90%
9/28/2020	1.64%	1.14%
9/29/2020	-0.40%	-0.27%
9/30/2020	0.69%	0.41%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
10/1/2020	0.78%	1.71%
10/2/2020	-0.78%	-1.91%
10/5/2020	1.81%	1.66%
10/6/2020	-1.20%	-0.61%
10/7/2020	1.69%	2.35%
10/8/2020	0.85%	0.11%
10/9/2020	0.85%	2.01%
10/12/2020	1.34%	1.33%
10/13/2020	-0.50%	0.81%
10/14/2020	-0.60%	-0.84%
10/15/2020	-0.08%	-0.20%
10/16/2020	-0.07%	0.37%
10/19/2020	-1.43%	-1.01%
10/20/2020	0.38%	-0.45%
10/21/2020	-0.34%	-0.91%
10/22/2020	0.61%	-0.51%
10/23/2020	0.38%	0.66%
10/26/2020	-1.83%	-2.53%
10/27/2020	-0.30%	0.77%
10/28/2020	-3.34%	-3.70%
10/29/2020	1.04%	0.66%
10/30/2020	-1.32%	-2.56%
11/2/2020	1.20%	-0.55%
11/3/2020	1.86%	2.12%
11/4/2020	1.94%	4.88%
11/5/2020	2.09%	2.51%
11/6/2020	0.00%	0.71%
11/9/2020	1.06%	-3.40%
11/10/2020	-0.06%	-3.38%
11/11/2020	0.80%	2.88%
11/12/2020	-0.97%	-0.31%
11/13/2020	1.32%	0.33%
11/16/2020	1.23%	-0.03%
11/17/2020	-0.15%	1.15%
11/18/2020	-0.91%	-0.78%
11/19/2020	0.58%	1.82%
11/20/2020	-0.43%	-0.36%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
11/23/2020	0.79%	-0.05%
11/24/2020	1.50%	0.43%
11/25/2020	0.02%	0.98%
11/27/2020	0.40%	1.66%
11/30/2020	-0.58%	0.26%
12/1/2020	0.96%	-0.68%
12/2/2020	0.12%	-0.82%
12/3/2020	0.23%	0.64%
12/4/2020	1.04%	0.95%
12/7/2020	-0.02%	0.43%
12/8/2020	0.43%	0.68%
12/9/2020	-0.96%	-2.50%
12/10/2020	0.26%	1.00%
12/11/2020	-0.23%	0.50%
12/14/2020	-0.33%	0.55%
12/15/2020	1.30%	0.24%
12/16/2020	0.14%	1.59%
12/17/2020	0.79%	1.67%
12/18/2020	-0.21%	1.28%
12/21/2020	-0.29%	0.13%
12/22/2020	0.06%	2.02%
12/23/2020	0.14%	-1.42%
12/24/2020	0.23%	0.08%
12/28/2020	0.38%	-1.51%
12/29/2020	-0.37%	-0.75%
12/30/2020	0.33%	0.07%
12/31/2020	0.36%	0.04%
1/4/2021	-1.32%	-1.90%
1/5/2021	0.90%	0.37%
1/6/2021	0.80%	-2.41%
1/7/2021	1.61%	2.74%
1/8/2021	0.47%	1.54%
1/11/2021	-0.57%	-0.95%
1/12/2021	0.42%	0.25%
1/13/2021	0.09%	-0.20%
1/14/2021	0.00%	-0.39%
1/15/2021	-0.86%	-0.55%



**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
1/19/2021	0.85%	1.31%
1/20/2021	1.20%	1.81%
1/21/2021	-0.09%	-0.49%
1/22/2021	-0.15%	0.23%
1/25/2021	0.24%	-0.28%
1/26/2021	-0.29%	-0.73%
1/27/2021	-2.51%	-2.18%
1/28/2021	0.92%	1.94%
1/29/2021	-1.78%	-1.64%
2/1/2021	1.71%	2.36%
2/2/2021	1.39%	2.60%
2/3/2021	0.14%	-0.37%
2/4/2021	1.12%	1.82%
2/5/2021	0.61%	1.19%
2/8/2021	0.97%	0.33%
2/9/2021	0.10%	0.89%
2/10/2021	-0.03%	-0.28%
2/11/2021	0.19%	0.79%
2/12/2021	0.47%	0.74%
2/16/2021	-0.11%	-0.20%
2/17/2021	-0.23%	-1.15%
2/18/2021	-0.66%	-0.29%
2/19/2021	0.27%	0.17%
2/22/2021	-0.97%	-3.12%
2/23/2021	-0.13%	-1.32%
2/24/2021	1.12%	1.09%
2/25/2021	-2.70%	-4.01%
2/26/2021	-0.39%	-0.04%
3/1/2021	2.45%	3.17%
3/2/2021	-0.91%	-2.06%
3/3/2021	-1.48%	-4.17%
3/4/2021	-1.68%	-2.83%
3/5/2021	1.72%	0.86%
3/8/2021	-0.59%	-2.90%
3/9/2021	1.67%	4.41%
3/10/2021	0.68%	-0.56%
3/11/2021	1.41%	3.00%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
3/12/2021	0.15%	-1.35%
3/15/2021	0.70%	0.97%
3/16/2021	-0.43%	-0.51%
3/17/2021	0.36%	-0.32%
3/18/2021	-1.81%	-3.68%
3/19/2021	0.18%	1.04%
3/22/2021	0.48%	1.56%
3/23/2021	-1.21%	0.10%
3/24/2021	-0.91%	-2.72%
3/25/2021	0.65%	-0.34%
3/26/2021	1.52%	2.05%
3/29/2021	-0.53%	-1.08%
3/30/2021	0.00%	-0.37%
3/31/2021	0.56%	2.24%
4/1/2021	1.27%	2.43%
4/5/2021	1.14%	1.11%
4/6/2021	0.03%	0.42%
4/7/2021	-0.15%	-0.36%
4/8/2021	0.59%	1.96%
4/9/2021	0.55%	0.67%
4/12/2021	-0.07%	0.29%
4/13/2021	0.39%	1.76%
4/14/2021	-0.29%	-1.15%
4/15/2021	1.00%	1.87%
4/16/2021	0.26%	-0.47%
4/19/2021	-0.70%	-1.61%
4/20/2021	-0.91%	-0.90%
4/21/2021	1.12%	0.52%
4/22/2021	-0.73%	-0.10%
4/23/2021	1.20%	1.42%
4/26/2021	0.44%	1.25%
4/27/2021	-0.02%	-0.42%
4/28/2021	0.01%	-0.33%
4/29/2021	0.35%	-1.68%
4/30/2021	-0.80%	-1.05%
5/3/2021	0.20%	-1.31%
5/4/2021	-0.85%	-2.34%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
5/5/2021	-0.01%	-0.87%
5/6/2021	0.48%	-0.64%
5/7/2021	0.86%	0.92%
5/10/2021	-1.24%	-2.36%
5/11/2021	-0.66%	1.06%
5/12/2021	-2.28%	-2.48%
5/13/2021	0.97%	-0.09%
5/14/2021	1.74%	2.80%
5/17/2021	-0.14%	-0.82%
5/18/2021	-0.60%	0.12%
5/19/2021	-0.38%	0.36%
5/20/2021	1.11%	2.27%
5/21/2021	-0.03%	-0.27%
5/24/2021	0.93%	1.59%
5/25/2021	-0.27%	0.23%
5/26/2021	0.45%	0.86%
5/27/2021	0.29%	-0.70%
5/28/2021	0.10%	0.70%
6/1/2021	0.17%	-0.59%
6/2/2021	0.17%	0.21%
6/3/2021	-0.52%	-1.10%
6/4/2021	0.84%	2.16%
6/7/2021	0.16%	0.79%
6/8/2021	0.18%	0.41%
6/9/2021	-0.29%	-0.10%
6/10/2021	0.40%	1.81%
6/11/2021	0.31%	1.05%
6/14/2021	0.13%	1.18%
6/15/2021	-0.30%	-1.30%
6/16/2021	-0.47%	-0.36%
6/17/2021	-0.14%	1.90%
6/18/2021	-1.26%	0.25%
6/21/2021	1.35%	0.46%
6/22/2021	0.49%	1.23%
6/23/2021	-0.01%	-0.04%
6/24/2021	0.65%	0.82%
6/25/2021	0.32%	0.06%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
6/28/2021	0.11%	1.22%
6/29/2021	0.00%	0.47%
6/30/2021	0.04%	-1.35%
7/1/2021	0.42%	0.15%
7/2/2021	0.50%	1.20%
7/6/2021	-0.30%	1.17%
7/7/2021	0.11%	0.28%
7/8/2021	-0.90%	-0.78%
7/9/2021	1.28%	0.59%
7/12/2021	0.22%	-0.86%
7/13/2021	-0.60%	-0.10%
7/14/2021	-0.24%	-0.66%
7/15/2021	-0.39%	-1.10%
7/16/2021	-0.76%	0.17%
7/19/2021	-1.47%	-0.43%
7/20/2021	1.68%	1.87%
7/21/2021	0.96%	0.81%
7/22/2021	0.03%	1.43%
7/23/2021	0.89%	0.72%
7/26/2021	0.16%	-0.08%
7/27/2021	-0.60%	-1.13%
7/28/2021	0.30%	0.73%
7/29/2021	0.45%	0.20%
7/30/2021	-0.56%	-0.42%
8/2/2021	-0.14%	0.02%
8/3/2021	0.68%	0.44%
8/4/2021	-0.40%	1.05%
8/5/2021	0.71%	0.94%
8/6/2021	0.08%	-0.44%
8/9/2021	-0.04%	-0.03%
8/10/2021	0.07%	-1.26%
8/11/2021	0.24%	-0.43%
8/12/2021	0.20%	1.15%
8/13/2021	0.03%	0.28%
8/16/2021	-0.08%	-0.79%
8/17/2021	-0.79%	-0.70%
8/18/2021	-0.89%	-0.46%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
8/19/2021	-0.23%	0.70%
8/20/2021	0.86%	1.25%
8/23/2021	1.05%	1.53%
8/24/2021	0.42%	0.87%
8/25/2021	0.26%	0.24%
8/26/2021	-0.65%	-0.34%
8/27/2021	1.09%	1.56%
8/30/2021	0.30%	0.51%
8/31/2021	-0.11%	-0.88%
9/1/2021	0.20%	0.41%
9/2/2021	0.41%	0.04%
9/3/2021	-0.01%	0.97%
9/7/2021	-0.42%	-1.10%
9/8/2021	-0.35%	-0.57%
9/9/2021	-0.29%	-0.15%
9/10/2021	-0.73%	-0.76%
9/13/2021	0.20%	-1.10%
9/14/2021	-0.62%	0.07%
9/15/2021	0.85%	1.13%
9/16/2021	-0.09%	0.76%
9/17/2021	-0.74%	-0.86%
9/20/2021	-1.84%	-1.66%
9/21/2021	0.09%	0.25%
9/22/2021	0.99%	0.96%
9/23/2021	1.20%	1.70%
9/24/2021	-0.01%	0.10%
9/27/2021	-0.10%	-1.78%
9/28/2021	-2.10%	-3.79%
9/29/2021	-0.01%	-0.28%
9/30/2021	-0.95%	-0.21%
10/1/2021	1.06%	1.48%
10/4/2021	-1.30%	-3.02%
10/5/2021	0.95%	1.59%
10/6/2021	0.28%	0.83%
10/7/2021	0.99%	1.18%
10/8/2021	-0.25%	-0.74%
10/11/2021	-0.64%	-0.18%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
10/12/2021	0.02%	1.22%
10/13/2021	0.48%	2.20%
10/14/2021	1.58%	1.62%
10/15/2021	0.57%	0.27%
10/18/2021	0.33%	1.29%
10/19/2021	0.68%	0.82%
10/20/2021	0.39%	-0.18%
10/21/2021	0.29%	1.03%
10/22/2021	-0.17%	0.14%
10/25/2021	0.55%	0.51%
10/26/2021	-0.01%	-0.30%
10/27/2021	-0.76%	-0.79%
10/28/2021	1.12%	1.21%
10/29/2021	0.10%	0.98%
11/1/2021	0.57%	-0.44%
11/2/2021	0.20%	0.30%
11/3/2021	0.73%	0.21%
11/4/2021	0.29%	0.95%
11/5/2021	0.40%	-0.83%
11/8/2021	0.20%	1.40%
11/9/2021	-0.29%	0.35%
11/10/2021	-1.05%	-2.90%
11/11/2021	0.24%	0.37%
11/12/2021	0.71%	1.65%
11/15/2021	-0.03%	-0.62%
11/16/2021	0.40%	1.37%
11/17/2021	-0.45%	-0.79%
11/18/2021	0.03%	-0.85%
11/19/2021	-0.29%	0.54%
11/22/2021	-0.62%	-2.99%
11/23/2021	-0.03%	-1.68%
11/24/2021	0.32%	0.63%
11/26/2021	-2.26%	-1.19%
11/29/2021	1.00%	2.24%
11/30/2021	-1.93%	-2.91%
12/1/2021	-1.52%	-4.41%
12/2/2021	1.53%	1.92%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
12/3/2021	-1.14%	-3.90%
12/6/2021	1.17%	0.12%
12/7/2021	2.13%	3.85%
12/8/2021	0.43%	0.91%
12/9/2021	-1.08%	-2.36%
12/10/2021	0.61%	1.53%
12/13/2021	-0.99%	-0.28%
12/14/2021	-0.77%	-3.34%
12/15/2021	1.49%	2.72%
12/16/2021	-1.01%	-3.42%
12/17/2021	-0.63%	0.42%
12/20/2021	-1.24%	-1.76%
12/21/2021	1.97%	2.81%
12/22/2021	0.95%	0.67%
12/23/2021	0.68%	0.49%
12/27/2021	1.20%	1.34%
12/28/2021	-0.24%	-1.10%
12/29/2021	0.06%	-0.19%
12/30/2021	-0.10%	0.19%
12/31/2021	-0.24%	-0.95%
1/3/2022	0.61%	-1.08%
1/4/2022	-0.24%	-2.39%
1/5/2022	-2.21%	-5.10%
1/6/2022	0.02%	0.20%
1/7/2022	-0.42%	-0.91%
1/10/2022	-0.19%	1.07%
1/11/2022	1.08%	1.62%
1/12/2022	0.18%	-0.38%
1/13/2022	-1.45%	-4.34%
1/14/2022	0.02%	0.33%
1/18/2022	-1.95%	-2.45%
1/19/2022	-0.94%	-0.07%
1/20/2022	-1.11%	-0.74%
1/21/2022	-2.01%	-2.88%
1/24/2022	0.42%	2.36%
1/25/2022	-1.25%	-4.08%
1/26/2022	-0.36%	-0.89%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
1/27/2022	-0.81%	-0.01%
1/28/2022	2.22%	3.99%
1/31/2022	2.22%	4.10%
2/1/2022	0.85%	0.43%
2/2/2022	0.47%	-1.15%
2/3/2022	-2.36%	-3.97%
2/4/2022	0.72%	2.79%
2/7/2022	-0.18%	-0.52%
2/8/2022	0.91%	1.31%
2/9/2022	1.61%	3.22%
2/10/2022	-1.64%	-1.75%
2/11/2022	-1.78%	-3.62%
2/14/2022	-0.41%	-0.29%
2/15/2022	1.75%	2.22%
2/16/2022	0.03%	-0.77%
2/17/2022	-2.15%	-4.78%
2/18/2022	-0.83%	-2.28%
2/22/2022	-1.13%	-0.76%
2/23/2022	-1.82%	-2.73%
2/24/2022	1.60%	6.36%
2/25/2022	2.19%	0.73%
2/28/2022	-0.04%	1.01%
3/1/2022	-1.51%	-0.84%
3/2/2022	1.76%	1.69%
3/3/2022	-0.81%	-2.71%
3/4/2022	-1.02%	-2.20%
3/7/2022	-2.96%	-4.51%
3/8/2022	-0.44%	-1.18%
3/9/2022	2.59%	4.92%
3/10/2022	-0.42%	-1.54%
3/11/2022	-1.38%	-3.19%
3/14/2022	-1.06%	-2.91%
3/15/2022	1.89%	2.63%
3/16/2022	2.51%	4.20%
3/17/2022	1.38%	2.44%
3/18/2022	1.22%	2.94%
3/21/2022	-0.17%	-0.92%



**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
3/22/2022	1.17%	2.50%
3/23/2022	-1.19%	-2.52%
3/24/2022	1.30%	1.81%
3/25/2022	0.31%	-1.46%
3/28/2022	0.61%	2.39%
3/29/2022	1.46%	2.47%
3/30/2022	-0.77%	-2.00%
3/31/2022	-1.46%	-0.97%
4/1/2022	0.45%	0.33%
4/4/2022	0.83%	2.51%
4/5/2022	-1.49%	-2.67%
4/6/2022	-1.13%	-3.20%
4/7/2022	0.25%	0.49%
4/8/2022	-0.32%	-1.66%
4/11/2022	-1.45%	-1.06%
4/12/2022	-0.27%	-0.70%
4/13/2022	1.33%	2.27%
4/14/2022	-1.18%	-2.56%
4/18/2022	-0.21%	-1.07%
4/19/2022	1.62%	2.78%
4/20/2022	-0.09%	-1.41%
4/21/2022	-1.70%	-3.35%
4/22/2022	-2.67%	-3.00%
4/25/2022	0.53%	2.14%
4/26/2022	-2.87%	-3.91%
4/27/2022	0.13%	0.28%
4/28/2022	2.27%	4.09%
4/29/2022	-3.41%	-4.14%
5/2/2022	0.59%	1.72%
5/3/2022	0.51%	-0.88%
5/4/2022	2.76%	3.06%
5/5/2022	-3.70%	-6.12%
5/6/2022	-0.84%	-3.13%
5/9/2022	-3.61%	-5.83%
5/10/2022	0.13%	1.53%
5/11/2022	-1.73%	-3.87%
5/12/2022	0.15%	1.00%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
5/13/2022	2.66%	5.01%
5/16/2022	-0.47%	-2.63%
5/17/2022	2.03%	1.67%
5/18/2022	-3.84%	-4.37%
5/19/2022	-0.21%	1.94%
5/20/2022	0.00%	1.39%
5/23/2022	1.63%	1.04%
5/24/2022	-1.07%	-3.20%
5/25/2022	1.11%	3.01%
5/26/2022	1.96%	2.27%
5/27/2022	2.42%	3.58%
5/31/2022	-0.70%	-2.00%
6/1/2022	-0.70%	0.53%
6/2/2022	2.01%	4.67%
6/3/2022	-1.55%	-2.41%
6/6/2022	0.30%	0.00%
6/7/2022	0.98%	1.62%
6/8/2022	-1.05%	-0.63%
6/9/2022	-2.39%	-2.53%
6/10/2022	-2.86%	-4.72%
6/13/2022	-4.15%	-6.05%
6/14/2022	-0.35%	0.69%
6/15/2022	1.49%	2.59%
6/16/2022	-3.48%	-4.74%
6/17/2022	0.40%	2.07%
6/21/2022	2.23%	1.86%
6/22/2022	-0.22%	0.20%
6/23/2022	0.91%	3.75%
6/24/2022	2.94%	4.37%
6/27/2022	-0.21%	-1.93%
6/28/2022	-1.89%	-3.89%
6/29/2022	-0.27%	0.29%
6/30/2022	-0.90%	-1.63%
7/1/2022	1.09%	1.61%
7/5/2022	0.20%	2.77%
7/6/2022	0.07%	0.05%
7/7/2022	1.68%	2.07%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
7/8/2022	-0.08%	-0.31%
7/11/2022	-1.32%	-1.77%
7/12/2022	-0.81%	-3.97%
7/13/2022	-0.34%	-0.96%
7/14/2022	-0.56%	-0.92%
7/15/2022	1.84%	2.57%
7/18/2022	-0.55%	-0.71%
7/19/2022	2.70%	2.97%
7/20/2022	0.78%	3.38%
7/21/2022	0.93%	1.80%
7/22/2022	-1.05%	-1.84%
7/25/2022	0.20%	-1.34%
7/26/2022	-1.19%	-3.29%
7/27/2022	2.50%	4.45%
7/28/2022	1.24%	1.95%
7/29/2022	1.33%	1.13%
8/1/2022	-0.22%	0.04%
8/2/2022	-0.53%	0.26%
8/3/2022	1.49%	3.20%
8/4/2022	-0.05%	0.13%
8/5/2022	-0.04%	0.31%
8/8/2022	0.12%	-0.05%
8/9/2022	-0.64%	-1.45%
8/10/2022	2.24%	3.92%
8/11/2022	-0.02%	-1.31%
8/12/2022	1.67%	2.05%
8/15/2022	0.28%	0.51%
8/16/2022	0.19%	-0.72%
8/17/2022	-0.92%	-1.71%
8/18/2022	0.27%	-0.09%
8/19/2022	-1.47%	-2.33%
8/22/2022	-2.05%	-2.86%
8/23/2022	-0.07%	-0.05%
8/24/2022	0.39%	0.69%
8/25/2022	1.41%	0.88%
8/26/2022	-3.24%	-3.96%
8/29/2022	-0.65%	-1.46%

**Exhibit-7****Market Index and Sector Index Logarithmic Returns**

16 June 2020 through 15 September 2022

<b>Date</b>	<b>Market Index Return</b>	<b>Sector Index Return</b>
8/30/2022	-1.15%	-0.15%
8/31/2022	-0.72%	-0.77%
9/1/2022	-0.11%	-1.54%
9/2/2022	-0.86%	-0.65%
9/6/2022	-0.49%	-0.78%
9/7/2022	1.81%	2.19%
9/8/2022	0.74%	1.35%
9/9/2022	1.65%	2.85%
9/12/2022	1.07%	1.29%
9/13/2022	-4.14%	-4.89%
9/14/2022	0.40%	0.08%
9/15/2022	-1.03%	-3.47%

**Sources:** CRSP (Market Index), S&P (Sector Index), and computations performed by Crowninshield Financial Research, Inc.

**Exhibit-8****Pegasystems Common Stock Regression Results**

Class Period: 16 June 2020 through 9 May 2022

<b>Regression Statistics</b>	
R Squared	0.693
Adjusted R Squared	0.686
Standard Error	1.37%
Observations	479

	<b>Coefficient</b>	<b>Standard Error</b>	<b>t-statistic</b>
Intercept	-0.07%	0.06%	-1.12
Market Index	0.254	0.101	2.52
Sector Index	0.852	0.058	14.65

**Source:** Computations performed by Crowninshield Financial Research, Inc.**Note:** Dummy variables were used to control for potentially abnormal returns on Pegasystems earnings announcement event dates. These dates were: 29 July 2020, 29 October 2020, 18 February 2021, 29 April 2021, 29 July 2021, 28 October 2021, 17 February 2022, and 29 April 2022.

**Exhibit-9****Pegasystems Common Stock Earnings Announcement Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t- statistic	Newey-West t-statistic
7/29/2020	\$114.59	\$104.36	9.35%	1.33%	2.05%	2.02%	7.33%	5.37 ***	5.35 ***
10/29/2020	\$118.70	\$120.27	-1.31%	1.04%	0.66%	0.75%	-2.07%	-1.51	-1.51
2/18/2021	\$143.11	\$141.74	0.96%	-0.66%	-0.29%	-0.49%	1.45%	1.06	1.06
4/29/2021	\$126.97	\$128.67	-1.33%	0.35%	-1.68%	-1.41%	0.08%	0.06	0.06
7/29/2021	\$127.35	\$136.89	-7.22%	0.45%	0.20%	0.21%	-7.44%	-5.44 ***	-5.43 ***
10/28/2021	\$118.31	\$124.46	-5.07%	1.12%	1.21%	1.25%	-6.31%	-4.62 ***	-4.61 ***
2/17/2022	\$82.28	\$97.52	-16.99%	-2.15%	-4.78%	-4.69%	-12.30%	-9.00 ***	-8.89 ***
4/29/2022	\$76.59	\$71.66	6.65%	-3.41%	-4.14%	-4.46%	11.11%	8.13 ***	8.00 ***

**Sources:** Company SEC Filings, CRSP, S&P, and computations performed by Crowninshield Financial Research, Inc.**Note:**

"\*\*\*" indicates statistical significance at the 99% confidence level.

"\*\*\*" indicates statistical significance at the 95% confidence level.

"\*\*\*" indicates statistical significance at the 90% confidence level.

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
6/16/2020	\$97.47	\$93.74	-	3.90%	1.75%	1.97%	2.05%	1.85%	1.36	1.35
6/17/2020	\$96.02	\$97.47	-	-1.50%	-0.41%	-0.34%	-0.46%	-1.04%	-0.76	-0.76
6/18/2020	\$96.51	\$96.02	-	0.51%	0.12%	1.51%	1.24%	-0.73%	-0.54	-0.54
6/19/2020	\$94.59	\$96.51	-	-2.01%	-0.46%	-0.13%	-0.30%	-1.71%	-1.25	-1.25
6/22/2020	\$94.96	\$94.59	-	0.39%	0.67%	2.10%	1.89%	-1.50%	-1.09	-1.09
6/23/2020	\$93.92	\$94.96	-	-1.10%	0.39%	-0.18%	-0.13%	-0.97%	-0.71	-0.71
6/24/2020	\$92.15	\$93.92	-	-1.90%	-2.61%	-2.18%	-2.59%	0.69%	0.50	0.50
6/25/2020	\$95.76	\$92.15	-	3.84%	1.12%	1.36%	1.37%	2.47%	1.81 *	1.80 *
6/26/2020	\$97.97	\$95.76	-	2.28%	-2.31%	-0.82%	-1.35%	3.64%	2.66 ***	2.63 ***
6/29/2020	\$97.56	\$97.97	-	-0.42%	1.44%	-0.22%	0.11%	-0.53%	-0.39	-0.38
6/30/2020	\$101.17	\$97.56	\$0.03	3.66%	1.46%	2.05%	2.04%	1.62%	1.19	1.18
7/1/2020	\$102.34	\$101.17	-	1.15%	0.40%	1.67%	1.45%	-0.30%	-0.22	-0.22
7/2/2020	\$103.00	\$102.34	-	0.64%	0.50%	0.33%	0.34%	0.30%	0.22	0.22
7/6/2020	\$102.50	\$103.00	-	-0.49%	1.48%	1.06%	1.21%	-1.69%	-1.24	-1.23
7/7/2020	\$99.69	\$102.50	-	-2.78%	-1.03%	-0.78%	-1.00%	-1.78%	-1.31	-1.30
7/8/2020	\$101.34	\$99.69	-	1.64%	0.84%	2.10%	1.93%	-0.29%	-0.21	-0.21
7/9/2020	\$101.28	\$101.34	-	-0.06%	-0.57%	0.80%	0.46%	-0.52%	-0.38	-0.38
7/10/2020	\$100.16	\$101.28	-	-1.11%	1.03%	-0.65%	-0.36%	-0.75%	-0.55	-0.55
7/13/2020	\$99.33	\$100.16	-	-0.83%	-1.13%	-4.49%	-4.18%	3.35%	2.45 **	2.42 **
7/14/2020	\$98.45	\$99.33	-	-0.89%	1.32%	0.44%	0.64%	-1.53%	-1.12	-1.11
7/15/2020	\$98.72	\$98.45	-	0.27%	1.17%	0.18%	0.38%	-0.10%	-0.08	-0.08
7/16/2020	\$98.16	\$98.72	-	-0.57%	-0.40%	-1.32%	-1.30%	0.73%	0.53	0.53
7/17/2020	\$100.51	\$98.16	-	2.37%	0.36%	1.00%	0.87%	1.50%	1.09	1.09
7/20/2020	\$104.19	\$100.51	-	3.60%	0.85%	3.80%	3.38%	0.21%	0.16	0.15
7/21/2020	\$104.26	\$104.19	-	0.07%	0.23%	-1.19%	-1.03%	1.09%	0.80	0.80
7/22/2020	\$105.46	\$104.26	-	1.14%	0.51%	0.40%	0.40%	0.74%	0.54	0.54
7/23/2020	\$103.73	\$105.46	-	-1.65%	-1.10%	-2.07%	-2.11%	0.46%	0.33	0.33
7/24/2020	\$101.92	\$103.73	-	-1.76%	-0.70%	-1.14%	-1.22%	-0.54%	-0.39	-0.39
7/27/2020	\$104.45	\$101.92	-	2.45%	0.90%	1.62%	1.53%	0.92%	0.67	0.67
7/28/2020	\$104.36	\$104.45	-	-0.09%	-0.69%	-0.84%	-0.97%	0.88%	0.64	0.64
7/29/2020	\$114.59	\$104.36	-	9.35%	1.33%	2.05%	2.02%	7.33%	5.37 ***	5.35 ***
7/30/2020	\$114.98	\$114.59	-	0.34%	-0.38%	-0.17%	-0.31%	0.65%	0.47	0.47
7/31/2020	\$116.89	\$114.98	-	1.65%	0.45%	0.73%	0.67%	0.98%	0.72	0.72
8/3/2020	\$118.32	\$116.89	-	1.22%	0.87%	2.01%	1.86%	-0.65%	-0.47	-0.47
8/4/2020	\$116.48	\$118.32	-	-1.57%	0.45%	-0.37%	-0.27%	-1.30%	-0.95	-0.95

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
8/5/2020	\$116.14	\$116.48	-	-0.29%	0.75%	0.58%	0.61%	-0.90%	-0.66	-0.66
8/6/2020	\$116.30	\$116.14	-	0.14%	0.46%	0.24%	0.25%	-0.11%	-0.08	-0.08
8/7/2020	\$114.66	\$116.30	-	-1.42%	0.02%	-2.32%	-2.04%	0.62%	0.45	0.45
8/10/2020	\$113.60	\$114.66	-	-0.93%	0.26%	-1.58%	-1.35%	0.42%	0.31	0.31
8/11/2020	\$114.50	\$113.60	-	0.79%	-0.80%	-1.72%	-1.74%	2.53%	1.85 *	1.85 *
8/12/2020	\$115.00	\$114.50	-	0.44%	1.29%	0.97%	1.08%	-0.64%	-0.47	-0.47
8/13/2020	\$116.81	\$115.00	-	1.56%	-0.06%	1.51%	1.20%	0.36%	0.27	0.26
8/14/2020	\$116.03	\$116.81	-	-0.67%	-0.07%	-0.51%	-0.52%	-0.15%	-0.11	-0.11
8/17/2020	\$117.47	\$116.03	-	1.23%	0.50%	1.22%	1.10%	0.14%	0.10	0.10
8/18/2020	\$117.94	\$117.47	-	0.40%	0.14%	1.16%	0.95%	-0.55%	-0.40	-0.40
8/19/2020	\$118.76	\$117.94	-	0.69%	-0.44%	-0.02%	-0.20%	0.90%	0.65	0.65
8/20/2020	\$119.82	\$118.76	-	0.89%	0.28%	2.02%	1.72%	-0.83%	-0.61	-0.61
8/21/2020	\$119.87	\$119.82	-	0.04%	0.16%	-0.71%	-0.63%	0.67%	0.49	0.49
8/24/2020	\$122.13	\$119.87	-	1.87%	0.89%	0.47%	0.55%	1.31%	0.96	0.96
8/25/2020	\$124.28	\$122.13	-	1.75%	0.34%	1.03%	0.90%	0.85%	0.62	0.62
8/26/2020	\$129.95	\$124.28	-	4.46%	0.87%	5.43%	4.78%	-0.32%	-0.23	-0.23
8/27/2020	\$127.90	\$129.95	-	-1.59%	0.17%	-0.44%	-0.40%	-1.19%	-0.87	-0.87
8/28/2020	\$128.97	\$127.90	-	0.83%	0.69%	1.09%	1.04%	-0.20%	-0.15	-0.15
8/31/2020	\$128.47	\$128.97	-	-0.39%	-0.16%	-0.21%	-0.29%	-0.10%	-0.07	-0.07
9/1/2020	\$132.72	\$128.47	-	3.25%	0.85%	2.93%	2.64%	0.61%	0.45	0.44
9/2/2020	\$134.82	\$132.72	-	1.57%	1.20%	0.51%	0.67%	0.90%	0.66	0.66
9/3/2020	\$127.94	\$134.82	-	-5.24%	-3.46%	-5.78%	-5.87%	0.63%	0.46	0.45
9/4/2020	\$124.26	\$127.94	-	-2.92%	-0.81%	-3.19%	-2.99%	0.07%	0.05	0.05
9/8/2020	\$120.01	\$124.26	-	-3.48%	-2.72%	-3.55%	-3.78%	0.30%	0.22	0.22
9/9/2020	\$125.16	\$120.01	-	4.20%	1.96%	2.79%	2.80%	1.40%	1.02	1.02
9/10/2020	\$122.38	\$125.16	-	-2.25%	-1.57%	-1.26%	-1.54%	-0.71%	-0.52	-0.51
9/11/2020	\$119.66	\$122.38	-	-2.25%	-0.02%	-1.44%	-1.30%	-0.94%	-0.69	-0.69
9/14/2020	\$121.32	\$119.66	-	1.38%	1.53%	1.88%	1.92%	-0.54%	-0.39	-0.39
9/15/2020	\$123.39	\$121.32	-	1.69%	0.54%	1.68%	1.50%	0.20%	0.14	0.14
9/16/2020	\$121.42	\$123.39	-	-1.61%	-0.32%	-1.56%	-1.48%	-0.13%	-0.10	-0.10
9/17/2020	\$119.52	\$121.42	-	-1.58%	-0.79%	-1.32%	-1.40%	-0.18%	-0.13	-0.13
9/18/2020	\$118.57	\$119.52	-	-0.80%	-0.89%	-0.56%	-0.77%	-0.03%	-0.02	-0.02
9/21/2020	\$120.09	\$118.57	-	1.27%	-1.26%	1.83%	1.17%	0.10%	0.08	0.07
9/22/2020	\$120.75	\$120.09	-	0.55%	0.93%	1.93%	1.81%	-1.26%	-0.92	-0.92
9/23/2020	\$116.13	\$120.75	-	-3.90%	-2.43%	-2.73%	-3.01%	-0.89%	-0.65	-0.64



**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
9/24/2020	\$115.99	\$116.13	-	-0.12%	0.20%	-0.46%	-0.41%	0.29%	0.21	0.21
9/25/2020	\$118.86	\$115.99	-	2.44%	1.56%	2.90%	2.79%	-0.35%	-0.26	-0.26
9/28/2020	\$120.28	\$118.86	-	1.19%	1.64%	1.14%	1.32%	-0.13%	-0.10	-0.10
9/29/2020	\$121.66	\$120.28	-	1.14%	-0.40%	-0.27%	-0.40%	1.54%	1.13	1.13
9/30/2020	\$121.04	\$121.66	\$0.03	-0.49%	0.69%	0.41%	0.45%	-0.94%	-0.69	-0.69
10/1/2020	\$123.97	\$121.04	-	2.39%	0.78%	1.71%	1.59%	0.81%	0.59	0.59
10/2/2020	\$121.78	\$123.97	-	-1.78%	-0.78%	-1.91%	-1.90%	0.11%	0.08	0.08
10/5/2020	\$125.46	\$121.78	-	2.98%	1.81%	1.66%	1.80%	1.18%	0.86	0.86
10/6/2020	\$128.26	\$125.46	-	2.21%	-1.20%	-0.61%	-0.90%	3.10%	2.27 **	2.26 **
10/7/2020	\$130.11	\$128.26	-	1.43%	1.69%	2.35%	2.36%	-0.93%	-0.68	-0.68
10/8/2020	\$128.90	\$130.11	-	-0.93%	0.85%	0.11%	0.24%	-1.18%	-0.86	-0.86
10/9/2020	\$131.36	\$128.90	-	1.89%	0.85%	2.01%	1.85%	0.04%	0.03	0.03
10/12/2020	\$132.73	\$131.36	-	1.04%	1.34%	1.33%	1.41%	-0.37%	-0.27	-0.27
10/13/2020	\$132.40	\$132.73	-	-0.25%	-0.50%	0.81%	0.49%	-0.74%	-0.54	-0.54
10/14/2020	\$131.49	\$132.40	-	-0.69%	-0.60%	-0.84%	-0.94%	0.25%	0.18	0.18
10/15/2020	\$130.05	\$131.49	-	-1.10%	-0.08%	-0.20%	-0.26%	-0.84%	-0.61	-0.61
10/16/2020	\$130.74	\$130.05	-	0.53%	-0.07%	0.37%	0.23%	0.30%	0.22	0.22
10/19/2020	\$129.21	\$130.74	-	-1.18%	-1.43%	-1.01%	-1.29%	0.11%	0.08	0.08
10/20/2020	\$129.27	\$129.21	-	0.05%	0.38%	-0.45%	-0.36%	0.41%	0.30	0.30
10/21/2020	\$129.91	\$129.27	-	0.49%	-0.34%	-0.91%	-0.93%	1.43%	1.04	1.04
10/22/2020	\$132.00	\$129.91	-	1.60%	0.61%	-0.51%	-0.35%	1.94%	1.42	1.42
10/23/2020	\$134.23	\$132.00	-	1.68%	0.38%	0.66%	0.59%	1.08%	0.79	0.79
10/26/2020	\$129.38	\$134.23	-	-3.68%	-1.83%	-2.53%	-2.69%	-0.99%	-0.73	-0.72
10/27/2020	\$123.91	\$129.38	-	-4.32%	-0.30%	0.77%	0.51%	-4.83%	-3.53 ***	-3.52 ***
10/28/2020	\$120.27	\$123.91	-	-2.98%	-3.34%	-3.70%	-4.07%	1.09%	0.79	0.78
10/29/2020	\$118.70	\$120.27	-	-1.31%	1.04%	0.66%	0.75%	-2.07%	-1.51	-1.51
10/30/2020	\$115.88	\$118.70	-	-2.40%	-1.32%	-2.56%	-2.59%	0.19%	0.14	0.13
11/2/2020	\$113.40	\$115.88	-	-2.16%	1.20%	-0.55%	-0.23%	-1.93%	-1.41	-1.40
11/3/2020	\$116.01	\$113.40	-	2.28%	1.86%	2.12%	2.21%	0.07%	0.05	0.05
11/4/2020	\$121.22	\$116.01	-	4.39%	1.94%	4.88%	4.58%	-0.19%	-0.14	-0.14
11/5/2020	\$123.69	\$121.22	-	2.02%	2.09%	2.51%	2.60%	-0.58%	-0.42	-0.42
11/6/2020	\$126.60	\$123.69	-	2.33%	0.00%	0.71%	0.53%	1.80%	1.31	1.31
11/9/2020	\$124.31	\$126.60	-	-1.83%	1.06%	-3.40%	-2.70%	0.87%	0.64	0.63
11/10/2020	\$121.31	\$124.31	-	-2.44%	-0.06%	-3.38%	-2.96%	0.52%	0.38	0.38
11/11/2020	\$123.34	\$121.31	-	1.66%	0.80%	2.88%	2.58%	-0.93%	-0.68	-0.67

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
11/12/2020	\$119.39	\$123.34	-	-3.25%	-0.97%	-0.31%	-0.58%	-2.67%	-1.95 *	-1.95 *
11/13/2020	\$120.86	\$119.39	-	1.22%	1.32%	0.33%	0.55%	0.68%	0.50	0.49
11/16/2020	\$121.82	\$120.86	-	0.79%	1.23%	-0.03%	0.22%	0.57%	0.42	0.42
11/17/2020	\$123.80	\$121.82	-	1.61%	-0.15%	1.15%	0.87%	0.74%	0.54	0.54
11/18/2020	\$122.50	\$123.80	-	-1.06%	-0.91%	-0.78%	-0.97%	-0.09%	-0.06	-0.06
11/19/2020	\$127.07	\$122.50	-	3.66%	0.58%	1.82%	1.62%	2.04%	1.49	1.49
11/20/2020	\$129.39	\$127.07	-	1.81%	-0.43%	-0.36%	-0.49%	2.30%	1.68 *	1.68 *
11/23/2020	\$129.52	\$129.39	-	0.10%	0.79%	-0.05%	0.08%	0.02%	0.01	0.01
11/24/2020	\$128.29	\$129.52	-	-0.95%	1.50%	0.43%	0.67%	-1.63%	-1.19	-1.18
11/25/2020	\$130.49	\$128.29	-	1.70%	0.02%	0.98%	0.77%	0.93%	0.68	0.68
11/27/2020	\$132.21	\$130.49	-	1.31%	0.40%	1.66%	1.44%	-0.13%	-0.10	-0.10
11/30/2020	\$130.88	\$132.21	-	-1.01%	-0.58%	0.26%	0.01%	-1.02%	-0.75	-0.74
12/1/2020	\$129.97	\$130.88	-	-0.70%	0.96%	-0.68%	-0.41%	-0.29%	-0.21	-0.21
12/2/2020	\$127.80	\$129.97	-	-1.68%	0.12%	-0.82%	-0.74%	-0.94%	-0.69	-0.69
12/3/2020	\$129.74	\$127.80	-	1.51%	0.23%	0.64%	0.53%	0.98%	0.71	0.71
12/4/2020	\$130.78	\$129.74	-	0.80%	1.04%	0.95%	1.01%	-0.21%	-0.15	-0.15
12/7/2020	\$128.06	\$130.78	-	-2.10%	-0.02%	0.43%	0.29%	-2.39%	-1.75 *	-1.75 *
12/8/2020	\$125.34	\$128.06	-	-2.15%	0.43%	0.68%	0.62%	-2.77%	-2.02 **	-2.02 **
12/9/2020	\$124.96	\$125.34	-	-0.30%	-0.96%	-2.50%	-2.44%	2.14%	1.57	1.56
12/10/2020	\$124.08	\$124.96	-	-0.71%	0.26%	1.00%	0.85%	-1.56%	-1.14	-1.14
12/11/2020	\$125.23	\$124.08	-	0.92%	-0.23%	0.50%	0.30%	0.63%	0.46	0.46
12/14/2020	\$125.42	\$125.23	-	0.15%	-0.33%	0.55%	0.31%	-0.16%	-0.12	-0.12
12/15/2020	\$125.57	\$125.42	-	0.12%	1.30%	0.24%	0.46%	-0.34%	-0.25	-0.25
12/16/2020	\$126.83	\$125.57	-	1.00%	0.14%	1.59%	1.32%	-0.32%	-0.24	-0.24
12/17/2020	\$132.98	\$126.83	-	4.74%	0.79%	1.67%	1.55%	3.19%	2.33 **	2.33 **
12/18/2020	\$133.38	\$132.98	-	0.30%	-0.21%	1.28%	0.96%	-0.66%	-0.49	-0.48
12/21/2020	\$133.84	\$133.38	-	0.34%	-0.29%	0.13%	-0.04%	0.38%	0.28	0.28
12/22/2020	\$137.07	\$133.84	-	2.38%	0.06%	2.02%	1.66%	0.72%	0.53	0.52
12/23/2020	\$139.82	\$137.07	-	1.99%	0.14%	-1.42%	-1.24%	3.23%	2.36 **	2.36 **
12/24/2020	\$138.63	\$139.82	-	-0.85%	0.23%	0.08%	0.06%	-0.91%	-0.67	-0.67
12/28/2020	\$133.30	\$138.63	-	-3.92%	0.38%	-1.51%	-1.26%	-2.66%	-1.95 *	-1.94 *
12/29/2020	\$130.65	\$133.30	-	-2.01%	-0.37%	-0.75%	-0.80%	-1.21%	-0.88	-0.88
12/30/2020	\$131.67	\$130.65	\$0.03	0.80%	0.33%	0.07%	0.07%	0.73%	0.53	0.53
12/31/2020	\$133.26	\$131.67	-	1.20%	0.36%	0.04%	0.05%	1.15%	0.84	0.84
1/4/2021	\$131.67	\$133.26	-	-1.20%	-1.32%	-1.90%	-2.02%	0.82%	0.60	0.60

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
1/5/2021	\$134.02	\$131.67	-	1.77%	0.90%	0.37%	0.47%	1.30%	0.95	0.95
1/6/2021	\$131.89	\$134.02	-	-1.60%	0.80%	-2.41%	-1.92%	0.32%	0.23	0.23
1/7/2021	\$136.23	\$131.89	-	3.24%	1.61%	2.74%	2.67%	0.57%	0.42	0.41
1/8/2021	\$136.11	\$136.23	-	-0.09%	0.47%	1.54%	1.36%	-1.45%	-1.06	-1.06
1/11/2021	\$135.00	\$136.11	-	-0.82%	-0.57%	-0.95%	-1.02%	0.20%	0.15	0.15
1/12/2021	\$132.50	\$135.00	-	-1.87%	0.42%	0.25%	0.25%	-2.12%	-1.55	-1.55
1/13/2021	\$131.83	\$132.50	-	-0.51%	0.09%	-0.20%	-0.22%	-0.29%	-0.21	-0.21
1/14/2021	\$133.50	\$131.83	-	1.26%	0.00%	-0.39%	-0.41%	1.66%	1.22	1.22
1/15/2021	\$134.17	\$133.50	-	0.50%	-0.86%	-0.55%	-0.75%	1.25%	0.92	0.91
1/19/2021	\$137.96	\$134.17	-	2.79%	0.85%	1.31%	1.27%	1.52%	1.11	1.11
1/20/2021	\$142.68	\$137.96	-	3.36%	1.20%	1.81%	1.77%	1.59%	1.16	1.16
1/21/2021	\$142.60	\$142.68	-	-0.06%	-0.09%	-0.49%	-0.51%	0.45%	0.33	0.33
1/22/2021	\$143.34	\$142.60	-	0.52%	-0.15%	0.23%	0.09%	0.43%	0.31	0.31
1/25/2021	\$137.25	\$143.34	-	-4.34%	0.24%	-0.28%	-0.25%	-4.10%	-3.00 ***	-2.99 ***
1/26/2021	\$136.24	\$137.25	-	-0.74%	-0.29%	-0.73%	-0.77%	0.03%	0.02	0.02
1/27/2021	\$133.48	\$136.24	-	-2.05%	-2.51%	-2.18%	-2.56%	0.51%	0.38	0.37
1/28/2021	\$131.66	\$133.48	-	-1.37%	0.92%	1.94%	1.82%	-3.19%	-2.34 **	-2.33 **
1/29/2021	\$127.45	\$131.66	-	-3.25%	-1.78%	-1.64%	-1.92%	-1.33%	-0.97	-0.97
2/1/2021	\$129.07	\$127.45	-	1.26%	1.71%	2.36%	2.38%	-1.11%	-0.81	-0.81
2/2/2021	\$134.88	\$129.07	-	4.40%	1.39%	2.60%	2.50%	1.91%	1.40	1.39
2/3/2021	\$134.68	\$134.88	-	-0.15%	0.14%	-0.37%	-0.35%	0.21%	0.15	0.15
2/4/2021	\$138.37	\$134.68	-	2.70%	1.12%	1.82%	1.76%	0.94%	0.69	0.69
2/5/2021	\$139.98	\$138.37	-	1.16%	0.61%	1.19%	1.09%	0.06%	0.05	0.05
2/8/2021	\$142.79	\$139.98	-	1.99%	0.97%	0.33%	0.46%	1.53%	1.12	1.12
2/9/2021	\$144.00	\$142.79	-	0.84%	0.10%	0.89%	0.71%	0.13%	0.10	0.10
2/10/2021	\$142.54	\$144.00	-	-1.02%	-0.03%	-0.28%	-0.32%	-0.70%	-0.51	-0.51
2/11/2021	\$146.01	\$142.54	-	2.41%	0.19%	0.79%	0.65%	1.76%	1.29	1.28
2/12/2021	\$146.71	\$146.01	-	0.48%	0.47%	0.74%	0.68%	-0.20%	-0.15	-0.15
2/16/2021	\$146.01	\$146.71	-	-0.48%	-0.11%	-0.20%	-0.27%	-0.21%	-0.16	-0.15
2/17/2021	\$141.74	\$146.01	-	-2.97%	-0.23%	-1.15%	-1.11%	-1.86%	-1.36	-1.36
2/18/2021	\$143.11	\$141.74	-	0.96%	-0.66%	-0.29%	-0.49%	1.45%	1.06	1.06
2/19/2021	\$146.21	\$143.11	-	2.14%	0.27%	0.17%	0.15%	2.00%	1.46	1.46
2/22/2021	\$146.55	\$146.21	-	0.23%	-0.97%	-3.12%	-2.97%	3.20%	2.34 **	2.33 **
2/23/2021	\$140.98	\$146.55	-	-3.87%	-0.13%	-1.32%	-1.23%	-2.65%	-1.94 *	-1.93 *
2/24/2021	\$139.31	\$140.98	-	-1.19%	1.12%	1.09%	1.14%	-2.33%	-1.71 *	-1.70 *

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
2/25/2021	\$130.71	\$139.31	-	-6.37%	-2.70%	-4.01%	-4.17%	-2.20%	-1.61	-1.59
2/26/2021	\$132.35	\$130.71	-	1.25%	-0.39%	-0.04%	-0.20%	1.45%	1.06	1.06
3/1/2021	\$136.08	\$132.35	-	2.78%	2.45%	3.17%	3.25%	-0.47%	-0.34	-0.34
3/2/2021	\$130.45	\$136.08	-	-4.23%	-0.91%	-2.06%	-2.06%	-2.17%	-1.59	-1.58
3/3/2021	\$124.00	\$130.45	-	-5.07%	-1.48%	-4.17%	-4.00%	-1.07%	-0.78	-0.78
3/4/2021	\$118.46	\$124.00	-	-4.57%	-1.68%	-2.83%	-2.91%	-1.66%	-1.21	-1.21
3/5/2021	\$121.08	\$118.46	-	2.19%	1.72%	0.86%	1.10%	1.09%	0.79	0.79
3/8/2021	\$114.72	\$121.08	-	-5.40%	-0.59%	-2.90%	-2.69%	-2.71%	-1.98 **	-1.97 **
3/9/2021	\$119.00	\$114.72	-	3.66%	1.67%	4.41%	4.11%	-0.44%	-0.32	-0.32
3/10/2021	\$119.99	\$119.00	-	0.83%	0.68%	-0.56%	-0.38%	1.21%	0.88	0.88
3/11/2021	\$124.19	\$119.99	-	3.44%	1.41%	3.00%	2.84%	0.60%	0.44	0.44
3/12/2021	\$123.40	\$124.19	-	-0.64%	0.15%	-1.35%	-1.18%	0.55%	0.40	0.40
3/15/2021	\$122.63	\$123.40	-	-0.63%	0.70%	0.97%	0.93%	-1.56%	-1.14	-1.14
3/16/2021	\$121.76	\$122.63	-	-0.71%	-0.43%	-0.51%	-0.61%	-0.10%	-0.07	-0.07
3/17/2021	\$120.10	\$121.76	-	-1.37%	0.36%	-0.32%	-0.25%	-1.12%	-0.82	-0.82
3/18/2021	\$112.38	\$120.10	-	-6.64%	-1.81%	-3.68%	-3.66%	-2.98%	-2.18 **	-2.16 **
3/19/2021	\$116.49	\$112.38	-	3.59%	0.18%	1.04%	0.86%	2.73%	2.00 **	1.99 **
3/22/2021	\$117.76	\$116.49	-	1.08%	0.48%	1.56%	1.38%	-0.29%	-0.22	-0.21
3/23/2021	\$115.74	\$117.76	-	-1.73%	-1.21%	0.10%	-0.29%	-1.44%	-1.05	-1.05
3/24/2021	\$113.49	\$115.74	-	-1.96%	-0.91%	-2.72%	-2.62%	0.66%	0.48	0.48
3/25/2021	\$113.01	\$113.49	-	-0.42%	0.65%	-0.34%	-0.20%	-0.23%	-0.17	-0.17
3/26/2021	\$116.76	\$113.01	-	3.26%	1.52%	2.05%	2.06%	1.20%	0.88	0.88
3/29/2021	\$112.53	\$116.76	-	-3.69%	-0.53%	-1.08%	-1.12%	-2.57%	-1.88 *	-1.87 *
3/30/2021	\$112.55	\$112.53	-	0.02%	0.00%	-0.37%	-0.39%	0.40%	0.29	0.29
3/31/2021	\$114.34	\$112.55	\$0.03	1.60%	0.56%	2.24%	1.98%	-0.38%	-0.27	-0.27
4/1/2021	\$117.99	\$114.34	-	3.14%	1.27%	2.43%	2.32%	0.82%	0.60	0.60
4/5/2021	\$117.91	\$117.99	-	-0.07%	1.14%	1.11%	1.16%	-1.23%	-0.90	-0.90
4/6/2021	\$120.04	\$117.91	-	1.79%	0.03%	0.42%	0.29%	1.50%	1.10	1.10
4/7/2021	\$118.26	\$120.04	-	-1.49%	-0.15%	-0.36%	-0.42%	-1.08%	-0.79	-0.79
4/8/2021	\$120.62	\$118.26	-	1.98%	0.59%	1.96%	1.75%	0.22%	0.16	0.16
4/9/2021	\$123.52	\$120.62	-	2.38%	0.55%	0.67%	0.64%	1.74%	1.27	1.27
4/12/2021	\$124.65	\$123.52	-	0.91%	-0.07%	0.29%	0.16%	0.76%	0.55	0.55
4/13/2021	\$128.78	\$124.65	-	3.26%	0.39%	1.76%	1.53%	1.73%	1.27	1.26
4/14/2021	\$127.86	\$128.78	-	-0.72%	-0.29%	-1.15%	-1.12%	0.40%	0.30	0.29
4/15/2021	\$131.71	\$127.86	-	2.97%	1.00%	1.87%	1.78%	1.19%	0.87	0.87

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
4/16/2021	\$129.89	\$131.71	-	-1.39%	0.26%	-0.47%	-0.40%	-0.99%	-0.72	-0.72
4/19/2021	\$128.59	\$129.89	-	-1.01%	-0.70%	-1.61%	-1.62%	0.61%	0.45	0.44
4/20/2021	\$126.77	\$128.59	-	-1.43%	-0.91%	-0.90%	-1.07%	-0.35%	-0.26	-0.26
4/21/2021	\$127.73	\$126.77	-	0.75%	1.12%	0.52%	0.65%	0.10%	0.07	0.07
4/22/2021	\$129.33	\$127.73	-	1.24%	-0.73%	-0.10%	-0.34%	1.59%	1.16	1.16
4/23/2021	\$130.79	\$129.33	-	1.12%	1.20%	1.42%	1.44%	-0.32%	-0.23	-0.23
4/26/2021	\$131.01	\$130.79	-	0.17%	0.44%	1.25%	1.11%	-0.94%	-0.69	-0.69
4/27/2021	\$129.30	\$131.01	-	-1.31%	-0.02%	-0.42%	-0.44%	-0.88%	-0.64	-0.64
4/28/2021	\$128.67	\$129.30	-	-0.49%	0.01%	-0.33%	-0.35%	-0.14%	-0.10	-0.10
4/29/2021	\$126.97	\$128.67	-	-1.33%	0.35%	-1.68%	-1.41%	0.08%	0.06	0.06
4/30/2021	\$126.94	\$126.97	-	-0.02%	-0.80%	-1.05%	-1.17%	1.14%	0.84	0.83
5/3/2021	\$124.06	\$126.94	-	-2.29%	0.20%	-1.31%	-1.13%	-1.16%	-0.85	-0.85
5/4/2021	\$121.29	\$124.06	-	-2.26%	-0.85%	-2.34%	-2.28%	0.02%	0.02	0.01
5/5/2021	\$118.06	\$121.29	-	-2.70%	-0.01%	-0.87%	-0.82%	-1.88%	-1.38	-1.37
5/6/2021	\$118.44	\$118.06	-	0.32%	0.48%	-0.64%	-0.50%	0.82%	0.60	0.60
5/7/2021	\$120.22	\$118.44	-	1.49%	0.86%	0.92%	0.93%	0.56%	0.41	0.41
5/10/2021	\$118.40	\$120.22	-	-1.53%	-1.24%	-2.36%	-2.40%	0.87%	0.64	0.63
5/11/2021	\$120.03	\$118.40	-	1.37%	-0.66%	1.06%	0.67%	0.70%	0.51	0.51
5/12/2021	\$116.64	\$120.03	-	-2.86%	-2.28%	-2.48%	-2.77%	-0.10%	-0.07	-0.07
5/13/2021	\$118.28	\$116.64	-	1.40%	0.97%	-0.09%	0.10%	1.30%	0.95	0.95
5/14/2021	\$120.35	\$118.28	-	1.73%	1.74%	2.80%	2.76%	-1.02%	-0.75	-0.74
5/17/2021	\$116.77	\$120.35	-	-3.02%	-0.14%	-0.82%	-0.81%	-2.21%	-1.62	-1.62
5/18/2021	\$118.52	\$116.77	-	1.49%	-0.60%	0.12%	-0.12%	1.61%	1.18	1.17
5/19/2021	\$117.86	\$118.52	-	-0.56%	-0.38%	0.36%	0.14%	-0.70%	-0.51	-0.51
5/20/2021	\$120.73	\$117.86	-	2.41%	1.11%	2.27%	2.15%	0.26%	0.19	0.19
5/21/2021	\$120.91	\$120.73	-	0.15%	-0.03%	-0.27%	-0.31%	0.46%	0.33	0.33
5/24/2021	\$122.02	\$120.91	-	0.91%	0.93%	1.59%	1.52%	-0.61%	-0.44	-0.44
5/25/2021	\$121.65	\$122.02	-	-0.30%	-0.27%	0.23%	0.06%	-0.36%	-0.26	-0.26
5/26/2021	\$120.68	\$121.65	-	-0.80%	0.45%	0.86%	0.78%	-1.58%	-1.16	-1.15
5/27/2021	\$120.24	\$120.68	-	-0.37%	0.29%	-0.70%	-0.60%	0.23%	0.17	0.17
5/28/2021	\$118.14	\$120.24	-	-1.76%	0.10%	0.70%	0.55%	-2.32%	-1.69 *	-1.69 *
6/1/2021	\$118.00	\$118.14	-	-0.12%	0.17%	-0.59%	-0.53%	0.42%	0.30	0.30
6/2/2021	\$117.68	\$118.00	-	-0.27%	0.17%	0.21%	0.15%	-0.42%	-0.31	-0.31
6/3/2021	\$116.02	\$117.68	-	-1.42%	-0.52%	-1.10%	-1.14%	-0.28%	-0.20	-0.20
6/4/2021	\$119.85	\$116.02	-	3.25%	0.84%	2.16%	1.98%	1.27%	0.93	0.92

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
6/7/2021	\$123.92	\$119.85	-	3.34%	0.16%	0.79%	0.65%	2.69%	1.97 **	1.97 **
6/8/2021	\$127.92	\$123.92	-	3.18%	0.18%	0.41%	0.33%	2.85%	2.09 **	2.08 **
6/9/2021	\$127.27	\$127.92	-	-0.51%	-0.29%	-0.10%	-0.23%	-0.28%	-0.21	-0.21
6/10/2021	\$128.56	\$127.27	-	1.01%	0.40%	1.81%	1.57%	-0.57%	-0.41	-0.41
6/11/2021	\$131.29	\$128.56	-	2.10%	0.31%	1.05%	0.90%	1.20%	0.88	0.87
6/14/2021	\$134.96	\$131.29	-	2.76%	0.13%	1.18%	0.97%	1.79%	1.31	1.30
6/15/2021	\$133.54	\$134.96	-	-1.06%	-0.30%	-1.30%	-1.25%	0.20%	0.14	0.14
6/16/2021	\$132.84	\$133.54	-	-0.53%	-0.47%	-0.36%	-0.50%	-0.03%	-0.02	-0.02
6/17/2021	\$136.44	\$132.84	-	2.67%	-0.14%	1.90%	1.52%	1.16%	0.85	0.84
6/18/2021	\$137.15	\$136.44	-	0.52%	-1.26%	0.25%	-0.18%	0.70%	0.51	0.51
6/21/2021	\$137.58	\$137.15	-	0.31%	1.35%	0.46%	0.66%	-0.35%	-0.25	-0.25
6/22/2021	\$138.35	\$137.58	-	0.56%	0.49%	1.23%	1.10%	-0.54%	-0.40	-0.39
6/23/2021	\$139.40	\$138.35	-	0.76%	-0.01%	-0.04%	-0.11%	0.86%	0.63	0.63
6/24/2021	\$139.54	\$139.40	-	0.10%	0.65%	0.82%	0.79%	-0.69%	-0.51	-0.51
6/25/2021	\$140.37	\$139.54	-	0.59%	0.32%	0.06%	0.06%	0.53%	0.39	0.39
6/28/2021	\$140.65	\$140.37	-	0.20%	0.11%	1.22%	1.00%	-0.80%	-0.58	-0.58
6/29/2021	\$141.92	\$140.65	-	0.90%	0.00%	0.47%	0.33%	0.57%	0.42	0.42
6/30/2021	\$139.19	\$141.92	\$0.03	-1.92%	0.04%	-1.35%	-1.21%	-0.71%	-0.52	-0.52
7/1/2021	\$138.33	\$139.19	-	-0.62%	0.42%	0.15%	0.16%	-0.78%	-0.57	-0.57
7/2/2021	\$139.97	\$138.33	-	1.18%	0.50%	1.20%	1.08%	0.10%	0.07	0.07
7/6/2021	\$140.06	\$139.97	-	0.06%	-0.30%	1.17%	0.85%	-0.79%	-0.57	-0.57
7/7/2021	\$138.78	\$140.06	-	-0.92%	0.11%	0.28%	0.19%	-1.11%	-0.81	-0.81
7/8/2021	\$137.53	\$138.78	-	-0.90%	-0.90%	-0.78%	-0.96%	0.06%	0.04	0.04
7/9/2021	\$137.52	\$137.53	-	-0.01%	1.28%	0.59%	0.76%	-0.76%	-0.56	-0.56
7/12/2021	\$136.25	\$137.52	-	-0.93%	0.22%	-0.86%	-0.75%	-0.18%	-0.13	-0.13
7/13/2021	\$135.66	\$136.25	-	-0.43%	-0.60%	-0.10%	-0.31%	-0.12%	-0.09	-0.09
7/14/2021	\$133.20	\$135.66	-	-1.83%	-0.24%	-0.66%	-0.69%	-1.14%	-0.83	-0.83
7/15/2021	\$131.38	\$133.20	-	-1.38%	-0.39%	-1.10%	-1.11%	-0.27%	-0.20	-0.20
7/16/2021	\$132.47	\$131.38	-	0.83%	-0.76%	0.17%	-0.12%	0.94%	0.69	0.69
7/19/2021	\$131.83	\$132.47	-	-0.48%	-1.47%	-0.43%	-0.81%	0.32%	0.24	0.23
7/20/2021	\$135.08	\$131.83	-	2.44%	1.68%	1.87%	1.95%	0.48%	0.35	0.35
7/21/2021	\$135.97	\$135.08	-	0.66%	0.96%	0.81%	0.86%	-0.20%	-0.15	-0.15
7/22/2021	\$136.00	\$135.97	-	0.02%	0.03%	1.43%	1.15%	-1.13%	-0.83	-0.83
7/23/2021	\$136.80	\$136.00	-	0.59%	0.89%	0.72%	0.77%	-0.18%	-0.13	-0.13
7/26/2021	\$136.64	\$136.80	-	-0.12%	0.16%	-0.08%	-0.10%	-0.02%	-0.01	-0.01

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
7/27/2021	\$133.99	\$136.64	-	-1.96%	-0.60%	-1.13%	-1.19%	-0.77%	-0.56	-0.56
7/28/2021	\$136.89	\$133.99	-	2.14%	0.30%	0.73%	0.62%	1.52%	1.11	1.11
7/29/2021	\$127.35	\$136.89	-	-7.22%	0.45%	0.20%	0.21%	-7.44%	-5.44 ***	-5.43 ***
7/30/2021	\$127.64	\$127.35	-	0.23%	-0.56%	-0.42%	-0.57%	0.80%	0.59	0.58
8/2/2021	\$127.01	\$127.64	-	-0.49%	-0.14%	0.02%	-0.09%	-0.40%	-0.30	-0.30
8/3/2021	\$126.99	\$127.01	-	-0.02%	0.68%	0.44%	0.47%	-0.49%	-0.36	-0.36
8/4/2021	\$126.75	\$126.99	-	-0.19%	-0.40%	1.05%	0.72%	-0.91%	-0.67	-0.67
8/5/2021	\$127.50	\$126.75	-	0.59%	0.71%	0.94%	0.91%	-0.32%	-0.24	-0.24
8/6/2021	\$128.60	\$127.50	-	0.86%	0.08%	-0.44%	-0.43%	1.29%	0.94	0.94
8/9/2021	\$128.86	\$128.60	-	0.20%	-0.04%	-0.03%	-0.11%	0.31%	0.23	0.23
8/10/2021	\$127.26	\$128.86	-	-1.25%	0.07%	-1.26%	-1.13%	-0.12%	-0.09	-0.09
8/11/2021	\$126.48	\$127.26	-	-0.61%	0.24%	-0.43%	-0.37%	-0.24%	-0.18	-0.18
8/12/2021	\$126.54	\$126.48	-	0.05%	0.20%	1.15%	0.96%	-0.92%	-0.67	-0.67
8/13/2021	\$127.31	\$126.54	-	0.61%	0.03%	0.28%	0.18%	0.43%	0.31	0.31
8/16/2021	\$127.50	\$127.31	-	0.15%	-0.08%	-0.79%	-0.77%	0.92%	0.67	0.67
8/17/2021	\$129.42	\$127.50	-	1.49%	-0.79%	-0.70%	-0.87%	2.36%	1.73 *	1.72 *
8/18/2021	\$130.52	\$129.42	-	0.85%	-0.89%	-0.46%	-0.69%	1.53%	1.12	1.12
8/19/2021	\$129.71	\$130.52	-	-0.62%	-0.23%	0.70%	0.46%	-1.09%	-0.80	-0.79
8/20/2021	\$131.54	\$129.71	-	1.40%	0.86%	1.25%	1.21%	0.19%	0.14	0.14
8/23/2021	\$132.51	\$131.54	-	0.73%	1.05%	1.53%	1.50%	-0.77%	-0.56	-0.56
8/24/2021	\$133.24	\$132.51	-	0.55%	0.42%	0.87%	0.78%	-0.23%	-0.17	-0.17
8/25/2021	\$133.93	\$133.24	-	0.52%	0.26%	0.24%	0.20%	0.32%	0.23	0.23
8/26/2021	\$134.57	\$133.93	-	0.48%	-0.65%	-0.34%	-0.52%	1.00%	0.73	0.73
8/27/2021	\$138.00	\$134.57	-	2.52%	1.09%	1.56%	1.54%	0.98%	0.72	0.71
8/30/2021	\$138.39	\$138.00	-	0.28%	0.30%	0.51%	0.44%	-0.15%	-0.11	-0.11
8/31/2021	\$137.63	\$138.39	-	-0.55%	-0.11%	-0.88%	-0.85%	0.30%	0.22	0.22
9/1/2021	\$141.10	\$137.63	-	2.49%	0.20%	0.41%	0.33%	2.16%	1.58	1.58
9/2/2021	\$141.01	\$141.10	-	-0.06%	0.41%	0.04%	0.07%	-0.14%	-0.10	-0.10
9/3/2021	\$142.39	\$141.01	-	0.97%	-0.01%	0.97%	0.75%	0.22%	0.16	0.16
9/7/2021	\$139.84	\$142.39	-	-1.81%	-0.42%	-1.10%	-1.12%	-0.69%	-0.50	-0.50
9/8/2021	\$137.59	\$139.84	-	-1.62%	-0.35%	-0.57%	-0.64%	-0.98%	-0.71	-0.71
9/9/2021	\$136.65	\$137.59	-	-0.69%	-0.29%	-0.15%	-0.28%	-0.41%	-0.30	-0.30
9/10/2021	\$133.31	\$136.65	-	-2.47%	-0.73%	-0.76%	-0.90%	-1.57%	-1.15	-1.15
9/13/2021	\$132.47	\$133.31	-	-0.63%	0.20%	-1.10%	-0.95%	0.32%	0.24	0.24
9/14/2021	\$130.17	\$132.47	-	-1.75%	-0.62%	0.07%	-0.17%	-1.58%	-1.16	-1.16

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
9/15/2021	\$132.26	\$130.17	-	1.59%	0.85%	1.13%	1.11%	0.49%	0.36	0.36
9/16/2021	\$131.96	\$132.26	-	-0.23%	-0.09%	0.76%	0.56%	-0.79%	-0.57	-0.57
9/17/2021	\$131.93	\$131.96	-	-0.02%	-0.74%	-0.86%	-0.99%	0.97%	0.71	0.71
9/20/2021	\$129.44	\$131.93	-	-1.91%	-1.84%	-1.66%	-1.96%	0.05%	0.04	0.04
9/21/2021	\$129.94	\$129.44	-	0.39%	0.09%	0.25%	0.16%	0.22%	0.16	0.16
9/22/2021	\$132.90	\$129.94	-	2.25%	0.99%	0.96%	1.00%	1.25%	0.92	0.92
9/23/2021	\$134.95	\$132.90	-	1.53%	1.20%	1.70%	1.68%	-0.15%	-0.11	-0.11
9/24/2021	\$132.73	\$134.95	-	-1.66%	-0.01%	0.10%	0.01%	-1.67%	-1.22	-1.22
9/27/2021	\$132.35	\$132.73	-	-0.29%	-0.10%	-1.78%	-1.62%	1.33%	0.97	0.97
9/28/2021	\$129.18	\$132.35	-	-2.42%	-2.10%	-3.79%	-3.83%	1.41%	1.03	1.02
9/29/2021	\$127.58	\$129.18	-	-1.25%	-0.01%	-0.28%	-0.31%	-0.94%	-0.69	-0.69
9/30/2021	\$127.10	\$127.58	\$0.03	-0.35%	-0.95%	-0.21%	-0.49%	0.14%	0.10	0.10
10/1/2021	\$128.61	\$127.10	-	1.18%	1.06%	1.48%	1.46%	-0.28%	-0.20	-0.20
10/4/2021	\$123.00	\$128.61	-	-4.46%	-1.30%	-3.02%	-2.98%	-1.48%	-1.09	-1.08
10/5/2021	\$124.56	\$123.00	-	1.26%	0.95%	1.59%	1.52%	-0.26%	-0.19	-0.19
10/6/2021	\$124.63	\$124.56	-	0.06%	0.28%	0.83%	0.71%	-0.65%	-0.48	-0.48
10/7/2021	\$126.45	\$124.63	-	1.45%	0.99%	1.18%	1.19%	0.26%	0.19	0.19
10/8/2021	\$124.46	\$126.45	-	-1.59%	-0.25%	-0.74%	-0.77%	-0.82%	-0.60	-0.60
10/11/2021	\$122.34	\$124.46	-	-1.72%	-0.64%	-0.18%	-0.39%	-1.33%	-0.97	-0.97
10/12/2021	\$124.09	\$122.34	-	1.42%	0.02%	1.22%	0.98%	0.44%	0.32	0.32
10/13/2021	\$126.05	\$124.09	-	1.57%	0.48%	2.20%	1.92%	-0.35%	-0.26	-0.26
10/14/2021	\$130.47	\$126.05	-	3.45%	1.58%	1.62%	1.71%	1.74%	1.27	1.27
10/15/2021	\$129.37	\$130.47	-	-0.85%	0.57%	0.27%	0.30%	-1.15%	-0.84	-0.84
10/18/2021	\$129.14	\$129.37	-	-0.18%	0.33%	1.29%	1.11%	-1.29%	-0.94	-0.94
10/19/2021	\$130.71	\$129.14	-	1.21%	0.68%	0.82%	0.80%	0.41%	0.30	0.30
10/20/2021	\$130.51	\$130.71	-	-0.15%	0.39%	-0.18%	-0.12%	-0.03%	-0.02	-0.02
10/21/2021	\$130.63	\$130.51	-	0.09%	0.29%	1.03%	0.88%	-0.79%	-0.57	-0.57
10/22/2021	\$128.61	\$130.63	-	-1.56%	-0.17%	0.14%	0.01%	-1.56%	-1.14	-1.14
10/25/2021	\$128.07	\$128.61	-	-0.42%	0.55%	0.51%	0.50%	-0.92%	-0.67	-0.67
10/26/2021	\$127.93	\$128.07	-	-0.11%	-0.01%	-0.30%	-0.33%	0.22%	0.16	0.16
10/27/2021	\$124.46	\$127.93	-	-2.75%	-0.76%	-0.79%	-0.93%	-1.82%	-1.33	-1.33
10/28/2021	\$118.31	\$124.46	-	-5.07%	1.12%	1.21%	1.25%	-6.31%	-4.62 ***	-4.61 ***
10/29/2021	\$118.72	\$118.31	-	0.35%	0.10%	0.98%	0.78%	-0.44%	-0.32	-0.32
11/1/2021	\$119.80	\$118.72	-	0.91%	0.57%	-0.44%	-0.30%	1.21%	0.89	0.88
11/2/2021	\$122.58	\$119.80	-	2.29%	0.20%	0.30%	0.24%	2.06%	1.51	1.50



**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
11/3/2021	\$121.80	\$122.58	-	-0.64%	0.73%	0.21%	0.29%	-0.93%	-0.68	-0.68
11/4/2021	\$120.61	\$121.80	-	-0.98%	0.29%	0.95%	0.81%	-1.80%	-1.31	-1.31
11/5/2021	\$120.11	\$120.61	-	-0.42%	0.40%	-0.83%	-0.67%	0.26%	0.19	0.19
11/8/2021	\$120.46	\$120.11	-	0.29%	0.20%	1.40%	1.17%	-0.88%	-0.65	-0.64
11/9/2021	\$121.09	\$120.46	-	0.52%	-0.29%	0.35%	0.15%	0.37%	0.27	0.27
11/10/2021	\$117.12	\$121.09	-	-3.33%	-1.05%	-2.90%	-2.81%	-0.52%	-0.38	-0.38
11/11/2021	\$117.41	\$117.12	-	0.25%	0.24%	0.37%	0.31%	-0.06%	-0.04	-0.04
11/12/2021	\$118.77	\$117.41	-	1.15%	0.71%	1.65%	1.52%	-0.37%	-0.27	-0.27
11/15/2021	\$118.45	\$118.77	-	-0.27%	-0.03%	-0.62%	-0.61%	0.34%	0.25	0.25
11/16/2021	\$120.54	\$118.45	-	1.75%	0.40%	1.37%	1.20%	0.55%	0.40	0.40
11/17/2021	\$117.33	\$120.54	-	-2.70%	-0.45%	-0.79%	-0.86%	-1.84%	-1.35	-1.34
11/18/2021	\$118.00	\$117.33	-	0.57%	0.03%	-0.85%	-0.79%	1.36%	0.99	0.99
11/19/2021	\$119.94	\$118.00	-	1.63%	-0.29%	0.54%	0.32%	1.31%	0.96	0.96
11/22/2021	\$119.34	\$119.94	-	-0.50%	-0.62%	-2.99%	-2.78%	2.28%	1.67 *	1.66 *
11/23/2021	\$117.04	\$119.34	-	-1.95%	-0.03%	-1.68%	-1.51%	-0.43%	-0.32	-0.32
11/24/2021	\$117.61	\$117.04	-	0.49%	0.32%	0.63%	0.54%	-0.06%	-0.04	-0.04
11/26/2021	\$114.85	\$117.61	-	-2.37%	-2.26%	-1.19%	-1.65%	-0.72%	-0.53	-0.52
11/29/2021	\$117.24	\$114.85	-	2.06%	1.00%	2.24%	2.09%	-0.03%	-0.03	-0.03
11/30/2021	\$114.82	\$117.24	-	-2.09%	-1.93%	-2.91%	-3.04%	0.96%	0.70	0.70
12/1/2021	\$109.36	\$114.82	-	-4.87%	-1.52%	-4.41%	-4.22%	-0.65%	-0.48	-0.47
12/2/2021	\$110.74	\$109.36	-	1.25%	1.53%	1.92%	1.96%	-0.70%	-0.51	-0.51
12/3/2021	\$109.49	\$110.74	-	-1.14%	-1.14%	-3.90%	-3.68%	2.55%	1.86 *	1.85 *
12/6/2021	\$110.58	\$109.49	-	0.99%	1.17%	0.12%	0.33%	0.66%	0.49	0.48
12/7/2021	\$112.94	\$110.58	-	2.11%	2.13%	3.85%	3.75%	-1.64%	-1.20	-1.19
12/8/2021	\$115.33	\$112.94	-	2.09%	0.43%	0.91%	0.81%	1.28%	0.94	0.94
12/9/2021	\$112.98	\$115.33	-	-2.06%	-1.08%	-2.36%	-2.36%	0.30%	0.22	0.22
12/10/2021	\$113.40	\$112.98	-	0.37%	0.61%	1.53%	1.38%	-1.01%	-0.74	-0.74
12/13/2021	\$115.87	\$113.40	-	2.15%	-0.99%	-0.28%	-0.56%	2.72%	1.99 **	1.98 **
12/14/2021	\$111.73	\$115.87	-	-3.64%	-0.77%	-3.34%	-3.11%	-0.52%	-0.38	-0.38
12/15/2021	\$108.49	\$111.73	-	-2.94%	1.49%	2.72%	2.62%	-5.57%	-4.07 ***	-4.06 ***
12/16/2021	\$104.20	\$108.49	-	-4.03%	-1.01%	-3.42%	-3.24%	-0.80%	-0.58	-0.58
12/17/2021	\$105.10	\$104.20	-	0.86%	-0.63%	0.42%	0.13%	0.73%	0.53	0.53
12/20/2021	\$101.24	\$105.10	-	-3.74%	-1.24%	-1.76%	-1.89%	-1.85%	-1.36	-1.35
12/21/2021	\$108.04	\$101.24	-	6.50%	1.97%	2.81%	2.82%	3.68%	2.69 ***	2.68 ***
12/22/2021	\$109.45	\$108.04	-	1.30%	0.95%	0.67%	0.74%	0.56%	0.41	0.41

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
12/23/2021	\$110.46	\$109.45	-	0.92%	0.68%	0.49%	0.52%	0.40%	0.29	0.29
12/27/2021	\$112.69	\$110.46	-	2.00%	1.20%	1.34%	1.37%	0.63%	0.46	0.46
12/28/2021	\$111.95	\$112.69	-	-0.66%	-0.24%	-1.10%	-1.07%	0.41%	0.30	0.30
12/29/2021	\$112.96	\$111.95	-	0.90%	0.06%	-0.19%	-0.22%	1.12%	0.82	0.81
12/30/2021	\$113.79	\$112.96	-	0.73%	-0.10%	0.19%	0.07%	0.66%	0.48	0.48
12/31/2021	\$111.82	\$113.79	\$0.03	-1.72%	-0.24%	-0.95%	-0.94%	-0.78%	-0.57	-0.57
1/3/2022	\$110.25	\$111.82	-	-1.41%	0.61%	-1.08%	-0.84%	-0.58%	-0.42	-0.42
1/4/2022	\$109.42	\$110.25	-	-0.76%	-0.24%	-2.39%	-2.17%	1.41%	1.03	1.03
1/5/2022	\$97.26	\$109.42	-	-11.78%	-2.21%	-5.10%	-4.98%	-6.80%	-4.97 ***	-4.91 ***
1/6/2022	\$99.95	\$97.26	-	2.73%	0.02%	0.20%	0.10%	2.63%	1.92 *	1.92 *
1/7/2022	\$99.21	\$99.95	-	-0.74%	-0.42%	-0.91%	-0.95%	0.20%	0.15	0.15
1/10/2022	\$98.69	\$99.21	-	-0.53%	-0.19%	1.07%	0.79%	-1.32%	-0.96	-0.96
1/11/2022	\$104.07	\$98.69	-	5.31%	1.08%	1.62%	1.58%	3.73%	2.73 ***	2.72 ***
1/12/2022	\$103.04	\$104.07	-	-0.99%	0.18%	-0.38%	-0.35%	-0.65%	-0.47	-0.47
1/13/2022	\$99.02	\$103.04	-	-3.98%	-1.45%	-4.34%	-4.14%	0.16%	0.12	0.11
1/14/2022	\$99.53	\$99.02	-	0.51%	0.02%	0.33%	0.21%	0.30%	0.22	0.22
1/18/2022	\$96.25	\$99.53	-	-3.35%	-1.95%	-2.45%	-2.66%	-0.69%	-0.51	-0.50
1/19/2022	\$96.47	\$96.25	-	0.23%	-0.94%	-0.07%	-0.37%	0.60%	0.44	0.43
1/20/2022	\$96.51	\$96.47	-	0.04%	-1.11%	-0.74%	-0.98%	1.03%	0.75	0.75
1/21/2022	\$92.06	\$96.51	-	-4.72%	-2.01%	-2.88%	-3.04%	-1.68%	-1.23	-1.22
1/24/2022	\$97.35	\$92.06	-	5.59%	0.42%	2.36%	2.05%	3.54%	2.59 ***	2.58 **
1/25/2022	\$95.32	\$97.35	-	-2.11%	-1.25%	-4.08%	-3.87%	1.76%	1.29	1.27
1/26/2022	\$92.83	\$95.32	-	-2.65%	-0.36%	-0.89%	-0.92%	-1.73%	-1.26	-1.26
1/27/2022	\$91.50	\$92.83	-	-1.44%	-0.81%	-0.01%	-0.28%	-1.16%	-0.85	-0.84
1/28/2022	\$95.52	\$91.50	-	4.30%	2.22%	3.99%	3.89%	0.41%	0.30	0.30
1/31/2022	\$99.22	\$95.52	-	3.80%	2.22%	4.10%	3.98%	-0.18%	-0.13	-0.13
2/1/2022	\$101.42	\$99.22	-	2.19%	0.85%	0.43%	0.51%	1.68%	1.23	1.23
2/2/2022	\$99.95	\$101.42	-	-1.46%	0.47%	-1.15%	-0.93%	-0.53%	-0.39	-0.39
2/3/2022	\$97.44	\$99.95	-	-2.54%	-2.36%	-3.97%	-4.06%	1.51%	1.11	1.10
2/4/2022	\$97.88	\$97.44	-	0.45%	0.72%	2.79%	2.49%	-2.04%	-1.49	-1.49
2/7/2022	\$98.27	\$97.88	-	0.40%	-0.18%	-0.52%	-0.56%	0.96%	0.70	0.70
2/8/2022	\$98.39	\$98.27	-	0.12%	0.91%	1.31%	1.28%	-1.16%	-0.85	-0.85
2/9/2022	\$101.91	\$98.39	-	3.52%	1.61%	3.22%	3.08%	0.43%	0.32	0.31
2/10/2022	\$98.81	\$101.91	-	-3.09%	-1.64%	-1.75%	-1.98%	-1.11%	-0.81	-0.81
2/11/2022	\$97.57	\$98.81	-	-1.26%	-1.78%	-3.62%	-3.61%	2.35%	1.72 *	1.70 *

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
2/14/2022	\$97.47	\$97.57	-	-0.10%	-0.41%	-0.29%	-0.42%	0.32%	0.23	0.23
2/15/2022	\$101.00	\$97.47	-	3.56%	1.75%	2.22%	2.27%	1.29%	0.94	0.94
2/16/2022	\$97.52	\$101.00	-	-3.51%	0.03%	-0.77%	-0.72%	-2.79%	-2.04 **	-2.04 **
2/17/2022	\$82.28	\$97.52	-	-16.99%	-2.15%	-4.78%	-4.69%	-12.30%	-9.00 ***	-8.89 ***
2/18/2022	\$82.38	\$82.28	-	0.12%	-0.83%	-2.28%	-2.22%	2.34%	1.71 *	1.71 *
2/22/2022	\$79.66	\$82.38	-	-3.36%	-1.13%	-0.76%	-1.01%	-2.35%	-1.72 *	-1.71 *
2/23/2022	\$77.54	\$79.66	-	-2.70%	-1.82%	-2.73%	-2.86%	0.16%	0.12	0.12
2/24/2022	\$81.22	\$77.54	-	4.64%	1.60%	6.36%	5.75%	-1.11%	-0.82	-0.80
2/25/2022	\$84.72	\$81.22	-	4.22%	2.19%	0.73%	1.11%	3.11%	2.27 **	2.25 **
2/28/2022	\$87.12	\$84.72	-	2.79%	-0.04%	1.01%	0.78%	2.01%	1.47	1.47
3/1/2022	\$85.40	\$87.12	-	-1.99%	-1.51%	-0.84%	-1.17%	-0.82%	-0.60	-0.60
3/2/2022	\$85.99	\$85.40	-	0.69%	1.76%	1.69%	1.82%	-1.13%	-0.83	-0.82
3/3/2022	\$83.13	\$85.99	-	-3.38%	-0.81%	-2.71%	-2.58%	-0.80%	-0.59	-0.58
3/4/2022	\$82.21	\$83.13	-	-1.11%	-1.02%	-2.20%	-2.20%	1.09%	0.80	0.79
3/7/2022	\$79.28	\$82.21	-	-3.63%	-2.96%	-4.51%	-4.66%	1.04%	0.76	0.75
3/8/2022	\$77.20	\$79.28	-	-2.66%	-0.44%	-1.18%	-1.18%	-1.47%	-1.08	-1.08
3/9/2022	\$80.23	\$77.20	-	3.85%	2.59%	4.92%	4.78%	-0.93%	-0.68	-0.67
3/10/2022	\$78.68	\$80.23	-	-1.95%	-0.42%	-1.54%	-1.49%	-0.46%	-0.34	-0.34
3/11/2022	\$73.13	\$78.68	-	-7.32%	-1.38%	-3.19%	-3.14%	-4.17%	-3.05 ***	-3.03 ***
3/14/2022	\$72.27	\$73.13	-	-1.18%	-1.06%	-2.91%	-2.82%	1.64%	1.20	1.19
3/15/2022	\$73.54	\$72.27	-	1.74%	1.89%	2.63%	2.65%	-0.91%	-0.66	-0.66
3/16/2022	\$75.86	\$73.54	-	3.11%	2.51%	4.20%	4.15%	-1.04%	-0.76	-0.75
3/17/2022	\$78.00	\$75.86	-	2.78%	1.38%	2.44%	2.36%	0.42%	0.31	0.31
3/18/2022	\$79.57	\$78.00	-	1.99%	1.22%	2.94%	2.75%	-0.75%	-0.55	-0.55
3/21/2022	\$79.02	\$79.57	-	-0.69%	-0.17%	-0.92%	-0.90%	0.20%	0.15	0.15
3/22/2022	\$82.31	\$79.02	-	4.08%	1.17%	2.50%	2.35%	1.73%	1.26	1.26
3/23/2022	\$79.52	\$82.31	-	-3.45%	-1.19%	-2.52%	-2.52%	-0.93%	-0.68	-0.68
3/24/2022	\$79.61	\$79.52	-	0.11%	1.30%	1.81%	1.80%	-1.69%	-1.24	-1.23
3/25/2022	\$77.82	\$79.61	-	-2.27%	0.31%	-1.46%	-1.23%	-1.04%	-0.76	-0.76
3/28/2022	\$79.82	\$77.82	-	2.54%	0.61%	2.39%	2.12%	0.42%	0.31	0.30
3/29/2022	\$82.71	\$79.82	-	3.56%	1.46%	2.47%	2.40%	1.15%	0.84	0.84
3/30/2022	\$80.80	\$82.71	-	-2.34%	-0.77%	-2.00%	-1.97%	-0.37%	-0.27	-0.27
3/31/2022	\$80.65	\$80.80	\$0.03	-0.15%	-1.46%	-0.97%	-1.27%	1.12%	0.82	0.82
4/1/2022	\$80.24	\$80.65	-	-0.51%	0.45%	0.33%	0.32%	-0.83%	-0.61	-0.61
4/4/2022	\$81.45	\$80.24	-	1.50%	0.83%	2.51%	2.28%	-0.78%	-0.57	-0.57

**Exhibit-10****Pegasystems Common Stock Event Study Results**

Class Period: 16 June 2020 through 9 May 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
4/5/2022	\$78.25	\$81.45	-	-4.01%	-1.49%	-2.67%	-2.72%	-1.28%	-0.94	-0.93
4/6/2022	\$74.94	\$78.25	-	-4.32%	-1.13%	-3.20%	-3.08%	-1.24%	-0.91	-0.90
4/7/2022	\$75.85	\$74.94	-	1.21%	0.25%	0.49%	0.41%	0.79%	0.58	0.58
4/8/2022	\$73.78	\$75.85	-	-2.77%	-0.32%	-1.66%	-1.57%	-1.20%	-0.88	-0.87
4/11/2022	\$75.74	\$73.78	-	2.62%	-1.45%	-1.06%	-1.34%	3.96%	2.90 ***	2.89 ***
4/12/2022	\$76.00	\$75.74	-	0.34%	-0.27%	-0.70%	-0.74%	1.08%	0.79	0.79
4/13/2022	\$76.76	\$76.00	-	1.00%	1.33%	2.27%	2.20%	-1.21%	-0.88	-0.88
4/14/2022	\$74.51	\$76.76	-	-2.98%	-1.18%	-2.56%	-2.55%	-0.42%	-0.31	-0.31
4/18/2022	\$74.11	\$74.51	-	-0.54%	-0.21%	-1.07%	-1.04%	0.50%	0.37	0.37
4/19/2022	\$75.73	\$74.11	-	2.16%	1.62%	2.78%	2.71%	-0.54%	-0.40	-0.40
4/20/2022	\$74.42	\$75.73	-	-1.74%	-0.09%	-1.41%	-1.29%	-0.45%	-0.33	-0.33
4/21/2022	\$72.44	\$74.42	-	-2.70%	-1.70%	-3.35%	-3.36%	0.66%	0.48	0.48
4/22/2022	\$71.94	\$72.44	-	-0.69%	-2.67%	-3.00%	-3.31%	2.62%	1.91 *	1.89 *
4/25/2022	\$73.27	\$71.94	-	1.83%	0.53%	2.14%	1.89%	-0.05%	-0.04	-0.04
4/26/2022	\$69.45	\$73.27	-	-5.35%	-2.87%	-3.91%	-4.13%	-1.22%	-0.90	-0.88
4/27/2022	\$68.66	\$69.45	-	-1.14%	0.13%	0.28%	0.20%	-1.34%	-0.98	-0.98
4/28/2022	\$71.66	\$68.66	-	4.28%	2.27%	4.09%	3.99%	0.29%	0.21	0.21
4/29/2022	\$76.59	\$71.66	-	6.65%	-3.41%	-4.14%	-4.46%	11.11%	8.13 ***	8.00 ***
5/2/2022	\$74.47	\$76.59	-	-2.81%	0.59%	1.72%	1.54%	-4.35%	-3.18 ***	-3.18 ***
5/3/2022	\$72.82	\$74.47	-	-2.24%	0.51%	-0.88%	-0.69%	-1.55%	-1.13	-1.13
5/4/2022	\$75.79	\$72.82	-	4.00%	2.76%	3.06%	3.24%	0.76%	0.56	0.55
5/5/2022	\$70.19	\$75.79	-	-7.68%	-3.70%	-6.12%	-6.22%	-1.46%	-1.06	-1.04
5/6/2022	\$68.54	\$70.19	-	-2.38%	-0.84%	-3.13%	-2.95%	0.57%	0.42	0.41
5/9/2022	\$65.93	\$68.54	-	-3.88%	-3.61%	-5.83%	-5.95%	2.07%	1.51	1.48

**Sources:** CRSP, S&P, and computations performed by Crowninshield Financial Research, Inc.**Note:**

"\*\*\*\*" indicates statistical significance at the 99% confidence level.

"\*\*\*" indicates statistical significance at the 95% confidence level.

"\*\*" indicates statistical significance at the 90% confidence level.

**Exhibit-11****Pegasystems Common Stock Regression Results**

Examination Period: 16 June 2020 through 15 September 2022

<b>Regression Statistics</b>	
R Squared	0.735
Adjusted R Squared	0.729
Standard Error	1.51%
Observations	569

	<b>Coefficient</b>	<b>Standard Error</b>	<b>t-statistic</b>
Intercept	-0.07%	0.06%	-1.10
Market Index	0.178	0.100	1.77
Sector Index	0.927	0.059	15.67

**Source:** Computations performed by Crowninshield Financial Research, Inc.**Note:** Dummy variables were used to control for potentially abnormal returns on Pegasystems earnings announcement event dates and the alleged corrective disclosure dates. These dates were: 29 July 2020, 29 October 2020, 18 February 2021, 29 April 2021, 29 July 2021, 28 October 2021, 17 February 2022, 29 April 2022, 10 May 2022, and 28 July 2022.

**Exhibit-12****Pegasystems Common Stock Earnings Announcement Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

<b>Date</b>	<b>PEGA Closing Price</b>	<b>PEGA Prior Day Closing Price</b>	<b>PEGA Logarithmic Return</b>	<b>Market Index Logarithmic Return</b>	<b>Sector Index Logarithmic Return</b>	<b>PEGA Explained Return</b>	<b>PEGA Residual Return</b>	<b>t- statistic</b>	<b>Newey-West t-statistic</b>
7/29/2020	\$114.59	\$104.36	9.35%	1.33%	2.05%	2.07%	7.28%	4.83 ***	4.82 ***
10/29/2020	\$118.70	\$120.27	-1.31%	1.04%	0.66%	0.73%	-2.04%	-1.35	-1.35
2/18/2021	\$143.11	\$141.74	0.96%	-0.66%	-0.29%	-0.46%	1.42%	0.94	0.94
4/29/2021	\$126.97	\$128.67	-1.33%	0.35%	-1.68%	-1.56%	0.23%	0.16	0.15
7/29/2021	\$127.35	\$136.89	-7.22%	0.45%	0.20%	0.19%	-7.42%	-4.92 ***	-4.91 ***
10/28/2021	\$118.31	\$124.46	-5.07%	1.12%	1.21%	1.25%	-6.32%	-4.19 ***	-4.18 ***
2/17/2022	\$82.28	\$97.52	-16.99%	-2.15%	-4.78%	-4.88%	-12.11%	-8.03 ***	-7.96 ***
4/29/2022	\$76.59	\$71.66	6.65%	-3.41%	-4.14%	-4.51%	11.16%	7.40 ***	7.33 ***
7/28/2022	\$40.24	\$47.55	-16.69%	1.24%	1.95%	1.96%	-18.65%	-12.36 ***	-12.34 ***

**Sources:** Company SEC Filings, CRSP, S&P, and computations performed by Crowninshield Financial Research, Inc.**Note:**

"\*\*\*" indicates statistical significance at the 99% confidence level.

"\*\*\*" indicates statistical significance at the 95% confidence level.

"\*\*\*" indicates statistical significance at the 90% confidence level.

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
6/16/2020	\$97.47	\$93.74	-	3.90%	1.75%	1.97%	2.06%	1.84%	1.22	1.22
6/17/2020	\$96.02	\$97.47	-	-1.50%	-0.41%	-0.34%	-0.46%	-1.04%	-0.69	-0.69
6/18/2020	\$96.51	\$96.02	-	0.51%	0.12%	1.51%	1.35%	-0.84%	-0.56	-0.55
6/19/2020	\$94.59	\$96.51	-	-2.01%	-0.46%	-0.13%	-0.27%	-1.74%	-1.15	-1.15
6/22/2020	\$94.96	\$94.59	-	0.39%	0.67%	2.10%	1.99%	-1.60%	-1.06	-1.06
6/23/2020	\$93.92	\$94.96	-	-1.10%	0.39%	-0.18%	-0.17%	-0.93%	-0.62	-0.62
6/24/2020	\$92.15	\$93.92	-	-1.90%	-2.61%	-2.18%	-2.56%	0.65%	0.43	0.43
6/25/2020	\$95.76	\$92.15	-	3.84%	1.12%	1.36%	1.39%	2.45%	1.63	1.62
6/26/2020	\$97.97	\$95.76	-	2.28%	-2.31%	-0.82%	-1.24%	3.52%	2.33 **	2.31 **
6/29/2020	\$97.56	\$97.97	-	-0.42%	1.44%	-0.22%	-0.02%	-0.40%	-0.27	-0.26
6/30/2020	\$101.17	\$97.56	\$0.03	3.66%	1.46%	2.05%	2.09%	1.58%	1.05	1.04
7/1/2020	\$102.34	\$101.17	-	1.15%	0.40%	1.67%	1.55%	-0.40%	-0.26	-0.26
7/2/2020	\$103.00	\$102.34	-	0.64%	0.50%	0.33%	0.33%	0.32%	0.21	0.21
7/6/2020	\$102.50	\$103.00	-	-0.49%	1.48%	1.06%	1.17%	-1.66%	-1.10	-1.10
7/7/2020	\$99.69	\$102.50	-	-2.78%	-1.03%	-0.78%	-0.97%	-1.81%	-1.20	-1.19
7/8/2020	\$101.34	\$99.69	-	1.64%	0.84%	2.10%	2.03%	-0.39%	-0.26	-0.26
7/9/2020	\$101.28	\$101.34	-	-0.06%	-0.57%	0.80%	0.57%	-0.63%	-0.42	-0.41
7/10/2020	\$100.16	\$101.28	-	-1.11%	1.03%	-0.65%	-0.49%	-0.63%	-0.41	-0.41
7/13/2020	\$99.33	\$100.16	-	-0.83%	-1.13%	-4.49%	-4.43%	3.60%	2.39 **	2.36 **
7/14/2020	\$98.45	\$99.33	-	-0.89%	1.32%	0.44%	0.57%	-1.46%	-0.97	-0.96
7/15/2020	\$98.72	\$98.45	-	0.27%	1.17%	0.18%	0.30%	-0.03%	-0.02	-0.02
7/16/2020	\$98.16	\$98.72	-	-0.57%	-0.40%	-1.32%	-1.37%	0.80%	0.53	0.53
7/17/2020	\$100.51	\$98.16	-	2.37%	0.36%	1.00%	0.92%	1.45%	0.96	0.96
7/20/2020	\$104.19	\$100.51	-	3.60%	0.85%	3.80%	3.60%	-0.01%	-0.01	0.00
7/21/2020	\$104.26	\$104.19	-	0.07%	0.23%	-1.19%	-1.13%	1.20%	0.79	0.79
7/22/2020	\$105.46	\$104.26	-	1.14%	0.51%	0.40%	0.40%	0.75%	0.50	0.50
7/23/2020	\$103.73	\$105.46	-	-1.65%	-1.10%	-2.07%	-2.18%	0.53%	0.35	0.35
7/24/2020	\$101.92	\$103.73	-	-1.76%	-0.70%	-1.14%	-1.25%	-0.51%	-0.33	-0.33
7/27/2020	\$104.45	\$101.92	-	2.45%	0.90%	1.62%	1.59%	0.86%	0.57	0.57
7/28/2020	\$104.36	\$104.45	-	-0.09%	-0.69%	-0.84%	-0.98%	0.89%	0.59	0.59
7/29/2020	\$114.59	\$104.36	-	9.35%	1.33%	2.05%	2.07%	7.28%	4.83 ***	4.82 ***
7/30/2020	\$114.98	\$114.59	-	0.34%	-0.38%	-0.17%	-0.29%	0.63%	0.42	0.42
7/31/2020	\$116.89	\$114.98	-	1.65%	0.45%	0.73%	0.69%	0.96%	0.64	0.64
8/3/2020	\$118.32	\$116.89	-	1.22%	0.87%	2.01%	1.95%	-0.73%	-0.49	-0.49
8/4/2020	\$116.48	\$118.32	-	-1.57%	0.45%	-0.37%	-0.33%	-1.24%	-0.82	-0.82

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
8/5/2020	\$116.14	\$116.48	-	-0.29%	0.75%	0.58%	0.60%	-0.89%	-0.59	-0.59
8/6/2020	\$116.30	\$116.14	-	0.14%	0.46%	0.24%	0.23%	-0.10%	-0.06	-0.06
8/7/2020	\$114.66	\$116.30	-	-1.42%	0.02%	-2.32%	-2.21%	0.79%	0.53	0.52
8/10/2020	\$113.60	\$114.66	-	-0.93%	0.26%	-1.58%	-1.49%	0.56%	0.37	0.37
8/11/2020	\$114.50	\$113.60	-	0.79%	-0.80%	-1.72%	-1.81%	2.60%	1.72 *	1.72 *
8/12/2020	\$115.00	\$114.50	-	0.44%	1.29%	0.97%	1.05%	-0.62%	-0.41	-0.41
8/13/2020	\$116.81	\$115.00	-	1.56%	-0.06%	1.51%	1.32%	0.24%	0.16	0.16
8/14/2020	\$116.03	\$116.81	-	-0.67%	-0.07%	-0.51%	-0.56%	-0.11%	-0.08	-0.08
8/17/2020	\$117.47	\$116.03	-	1.23%	0.50%	1.22%	1.15%	0.08%	0.05	0.05
8/18/2020	\$117.94	\$117.47	-	0.40%	0.14%	1.16%	1.03%	-0.63%	-0.42	-0.42
8/19/2020	\$118.76	\$117.94	-	0.69%	-0.44%	-0.02%	-0.17%	0.86%	0.57	0.57
8/20/2020	\$119.82	\$118.76	-	0.89%	0.28%	2.02%	1.85%	-0.96%	-0.64	-0.64
8/21/2020	\$119.87	\$119.82	-	0.04%	0.16%	-0.71%	-0.70%	0.74%	0.49	0.49
8/24/2020	\$122.13	\$119.87	-	1.87%	0.89%	0.47%	0.52%	1.35%	0.89	0.89
8/25/2020	\$124.28	\$122.13	-	1.75%	0.34%	1.03%	0.95%	0.80%	0.53	0.53
8/26/2020	\$129.95	\$124.28	-	4.46%	0.87%	5.43%	5.12%	-0.66%	-0.44	-0.43
8/27/2020	\$127.90	\$129.95	-	-1.59%	0.17%	-0.44%	-0.45%	-1.14%	-0.76	-0.76
8/28/2020	\$128.97	\$127.90	-	0.83%	0.69%	1.09%	1.07%	-0.23%	-0.16	-0.15
8/31/2020	\$128.47	\$128.97	-	-0.39%	-0.16%	-0.21%	-0.29%	-0.10%	-0.06	-0.06
9/1/2020	\$132.72	\$128.47	-	3.25%	0.85%	2.93%	2.80%	0.45%	0.30	0.30
9/2/2020	\$134.82	\$132.72	-	1.57%	1.20%	0.51%	0.61%	0.96%	0.63	0.63
9/3/2020	\$127.94	\$134.82	-	-5.24%	-3.46%	-5.78%	-6.04%	0.80%	0.53	0.53
9/4/2020	\$124.26	\$127.94	-	-2.92%	-0.81%	-3.19%	-3.17%	0.25%	0.17	0.17
9/8/2020	\$120.01	\$124.26	-	-3.48%	-2.72%	-3.55%	-3.84%	0.36%	0.24	0.24
9/9/2020	\$125.16	\$120.01	-	4.20%	1.96%	2.79%	2.86%	1.34%	0.89	0.88
9/10/2020	\$122.38	\$125.16	-	-2.25%	-1.57%	-1.26%	-1.51%	-0.73%	-0.49	-0.48
9/11/2020	\$119.66	\$122.38	-	-2.25%	-0.02%	-1.44%	-1.41%	-0.84%	-0.56	-0.55
9/14/2020	\$121.32	\$119.66	-	1.38%	1.53%	1.88%	1.94%	-0.56%	-0.37	-0.37
9/15/2020	\$123.39	\$121.32	-	1.69%	0.54%	1.68%	1.58%	0.11%	0.07	0.07
9/16/2020	\$121.42	\$123.39	-	-1.61%	-0.32%	-1.56%	-1.57%	-0.04%	-0.03	-0.03
9/17/2020	\$119.52	\$121.42	-	-1.58%	-0.79%	-1.32%	-1.44%	-0.14%	-0.09	-0.09
9/18/2020	\$118.57	\$119.52	-	-0.80%	-0.89%	-0.56%	-0.75%	-0.05%	-0.03	-0.03
9/21/2020	\$120.09	\$118.57	-	1.27%	-1.26%	1.83%	1.40%	-0.13%	-0.09	-0.09
9/22/2020	\$120.75	\$120.09	-	0.55%	0.93%	1.93%	1.88%	-1.33%	-0.88	-0.88
9/23/2020	\$116.13	\$120.75	-	-3.90%	-2.43%	-2.73%	-3.03%	-0.87%	-0.58	-0.57



**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
9/24/2020	\$115.99	\$116.13	-	-0.12%	0.20%	-0.46%	-0.46%	0.34%	0.22	0.22
9/25/2020	\$118.86	\$115.99	-	2.44%	1.56%	2.90%	2.89%	-0.45%	-0.30	-0.30
9/28/2020	\$120.28	\$118.86	-	1.19%	1.64%	1.14%	1.28%	-0.09%	-0.06	-0.06
9/29/2020	\$121.66	\$120.28	-	1.14%	-0.40%	-0.27%	-0.39%	1.53%	1.02	1.01
9/30/2020	\$121.04	\$121.66	\$0.03	-0.49%	0.69%	0.41%	0.43%	-0.92%	-0.61	-0.61
10/1/2020	\$123.97	\$121.04	-	2.39%	0.78%	1.71%	1.66%	0.74%	0.49	0.49
10/2/2020	\$121.78	\$123.97	-	-1.78%	-0.78%	-1.91%	-1.98%	0.20%	0.13	0.13
10/5/2020	\$125.46	\$121.78	-	2.98%	1.81%	1.66%	1.79%	1.19%	0.79	0.79
10/6/2020	\$128.26	\$125.46	-	2.21%	-1.20%	-0.61%	-0.85%	3.06%	2.03 **	2.02 **
10/7/2020	\$130.11	\$128.26	-	1.43%	1.69%	2.35%	2.41%	-0.98%	-0.65	-0.65
10/8/2020	\$128.90	\$130.11	-	-0.93%	0.85%	0.11%	0.19%	-1.12%	-0.74	-0.74
10/9/2020	\$131.36	\$128.90	-	1.89%	0.85%	2.01%	1.94%	-0.05%	-0.03	-0.03
10/12/2020	\$132.73	\$131.36	-	1.04%	1.34%	1.33%	1.40%	-0.37%	-0.24	-0.24
10/13/2020	\$132.40	\$132.73	-	-0.25%	-0.50%	0.81%	0.59%	-0.84%	-0.56	-0.56
10/14/2020	\$131.49	\$132.40	-	-0.69%	-0.60%	-0.84%	-0.95%	0.26%	0.18	0.17
10/15/2020	\$130.05	\$131.49	-	-1.10%	-0.08%	-0.20%	-0.27%	-0.83%	-0.55	-0.55
10/16/2020	\$130.74	\$130.05	-	0.53%	-0.07%	0.37%	0.26%	0.27%	0.18	0.18
10/19/2020	\$129.21	\$130.74	-	-1.18%	-1.43%	-1.01%	-1.26%	0.08%	0.05	0.05
10/20/2020	\$129.27	\$129.21	-	0.05%	0.38%	-0.45%	-0.42%	0.47%	0.31	0.31
10/21/2020	\$129.91	\$129.27	-	0.49%	-0.34%	-0.91%	-0.97%	1.47%	0.97	0.97
10/22/2020	\$132.00	\$129.91	-	1.60%	0.61%	-0.51%	-0.43%	2.03%	1.34	1.34
10/23/2020	\$134.23	\$132.00	-	1.68%	0.38%	0.66%	0.61%	1.06%	0.70	0.70
10/26/2020	\$129.38	\$134.23	-	-3.68%	-1.83%	-2.53%	-2.74%	-0.94%	-0.62	-0.62
10/27/2020	\$123.91	\$129.38	-	-4.32%	-0.30%	0.77%	0.59%	-4.91%	-3.25 ***	-3.25 ***
10/28/2020	\$120.27	\$123.91	-	-2.98%	-3.34%	-3.70%	-4.09%	1.11%	0.74	0.73
10/29/2020	\$118.70	\$120.27	-	-1.31%	1.04%	0.66%	0.73%	-2.04%	-1.35	-1.35
10/30/2020	\$115.88	\$118.70	-	-2.40%	-1.32%	-2.56%	-2.68%	0.28%	0.18	0.18
11/2/2020	\$113.40	\$115.88	-	-2.16%	1.20%	-0.55%	-0.37%	-1.80%	-1.19	-1.18
11/3/2020	\$116.01	\$113.40	-	2.28%	1.86%	2.12%	2.23%	0.05%	0.03	0.03
11/4/2020	\$121.22	\$116.01	-	4.39%	1.94%	4.88%	4.80%	-0.41%	-0.27	-0.27
11/5/2020	\$123.69	\$121.22	-	2.02%	2.09%	2.51%	2.63%	-0.61%	-0.41	-0.40
11/6/2020	\$126.60	\$123.69	-	2.33%	0.00%	0.71%	0.58%	1.74%	1.15	1.15
11/9/2020	\$124.31	\$126.60	-	-1.83%	1.06%	-3.40%	-3.03%	1.21%	0.80	0.79
11/10/2020	\$121.31	\$124.31	-	-2.44%	-0.06%	-3.38%	-3.21%	0.77%	0.51	0.50
11/11/2020	\$123.34	\$121.31	-	1.66%	0.80%	2.88%	2.74%	-1.08%	-0.72	-0.71

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
11/12/2020	\$119.39	\$123.34	-	-3.25%	-0.97%	-0.31%	-0.53%	-2.72%	-1.80 *	-1.80 *
11/13/2020	\$120.86	\$119.39	-	1.22%	1.32%	0.33%	0.47%	0.75%	0.50	0.50
11/16/2020	\$121.82	\$120.86	-	0.79%	1.23%	-0.03%	0.12%	0.67%	0.44	0.44
11/17/2020	\$123.80	\$121.82	-	1.61%	-0.15%	1.15%	0.97%	0.64%	0.42	0.42
11/18/2020	\$122.50	\$123.80	-	-1.06%	-0.91%	-0.78%	-0.96%	-0.10%	-0.07	-0.06
11/19/2020	\$127.07	\$122.50	-	3.66%	0.58%	1.82%	1.72%	1.95%	1.29	1.29
11/20/2020	\$129.39	\$127.07	-	1.81%	-0.43%	-0.36%	-0.48%	2.29%	1.52	1.52
11/23/2020	\$129.52	\$129.39	-	0.10%	0.79%	-0.05%	0.02%	0.08%	0.05	0.05
11/24/2020	\$128.29	\$129.52	-	-0.95%	1.50%	0.43%	0.59%	-1.54%	-1.02	-1.02
11/25/2020	\$130.49	\$128.29	-	1.70%	0.02%	0.98%	0.84%	0.86%	0.57	0.57
11/27/2020	\$132.21	\$130.49	-	1.31%	0.40%	1.66%	1.54%	-0.23%	-0.15	-0.15
11/30/2020	\$130.88	\$132.21	-	-1.01%	-0.58%	0.26%	0.07%	-1.08%	-0.72	-0.72
12/1/2020	\$129.97	\$130.88	-	-0.70%	0.96%	-0.68%	-0.53%	-0.16%	-0.11	-0.11
12/2/2020	\$127.80	\$129.97	-	-1.68%	0.12%	-0.82%	-0.81%	-0.87%	-0.58	-0.58
12/3/2020	\$129.74	\$127.80	-	1.51%	0.23%	0.64%	0.56%	0.94%	0.63	0.63
12/4/2020	\$130.78	\$129.74	-	0.80%	1.04%	0.95%	1.00%	-0.20%	-0.13	-0.13
12/7/2020	\$128.06	\$130.78	-	-2.10%	-0.02%	0.43%	0.33%	-2.43%	-1.61	-1.61
12/8/2020	\$125.34	\$128.06	-	-2.15%	0.43%	0.68%	0.64%	-2.79%	-1.85 *	-1.84 *
12/9/2020	\$124.96	\$125.34	-	-0.30%	-0.96%	-2.50%	-2.56%	2.25%	1.49	1.49
12/10/2020	\$124.08	\$124.96	-	-0.71%	0.26%	1.00%	0.91%	-1.61%	-1.07	-1.07
12/11/2020	\$125.23	\$124.08	-	0.92%	-0.23%	0.50%	0.35%	0.57%	0.38	0.38
12/14/2020	\$125.42	\$125.23	-	0.15%	-0.33%	0.55%	0.38%	-0.23%	-0.15	-0.15
12/15/2020	\$125.57	\$125.42	-	0.12%	1.30%	0.24%	0.38%	-0.26%	-0.17	-0.17
12/16/2020	\$126.83	\$125.57	-	1.00%	0.14%	1.59%	1.43%	-0.43%	-0.29	-0.29
12/17/2020	\$132.98	\$126.83	-	4.74%	0.79%	1.67%	1.62%	3.12%	2.07 **	2.06 **
12/18/2020	\$133.38	\$132.98	-	0.30%	-0.21%	1.28%	1.08%	-0.78%	-0.51	-0.51
12/21/2020	\$133.84	\$133.38	-	0.34%	-0.29%	0.13%	-0.01%	0.35%	0.23	0.23
12/22/2020	\$137.07	\$133.84	-	2.38%	0.06%	2.02%	1.81%	0.57%	0.38	0.38
12/23/2020	\$139.82	\$137.07	-	1.99%	0.14%	-1.42%	-1.36%	3.35%	2.22 **	2.21 **
12/24/2020	\$138.63	\$139.82	-	-0.85%	0.23%	0.08%	0.05%	-0.90%	-0.60	-0.60
12/28/2020	\$133.30	\$138.63	-	-3.92%	0.38%	-1.51%	-1.40%	-2.52%	-1.67 *	-1.67 *
12/29/2020	\$130.65	\$133.30	-	-2.01%	-0.37%	-0.75%	-0.83%	-1.18%	-0.78	-0.78
12/30/2020	\$131.67	\$130.65	\$0.03	0.80%	0.33%	0.07%	0.05%	0.75%	0.50	0.50
12/31/2020	\$133.26	\$131.67	-	1.20%	0.36%	0.04%	0.03%	1.17%	0.78	0.78
1/4/2021	\$131.67	\$133.26	-	-1.20%	-1.32%	-1.90%	-2.07%	0.87%	0.57	0.57

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
1/5/2021	\$134.02	\$131.67	-	1.77%	0.90%	0.37%	0.43%	1.34%	0.89	0.89
1/6/2021	\$131.89	\$134.02	-	-1.60%	0.80%	-2.41%	-2.16%	0.56%	0.37	0.36
1/7/2021	\$136.23	\$131.89	-	3.24%	1.61%	2.74%	2.75%	0.49%	0.32	0.32
1/8/2021	\$136.11	\$136.23	-	-0.09%	0.47%	1.54%	1.44%	-1.53%	-1.01	-1.01
1/11/2021	\$135.00	\$136.11	-	-0.82%	-0.57%	-0.95%	-1.05%	0.23%	0.15	0.15
1/12/2021	\$132.50	\$135.00	-	-1.87%	0.42%	0.25%	0.24%	-2.11%	-1.40	-1.39
1/13/2021	\$131.83	\$132.50	-	-0.51%	0.09%	-0.20%	-0.24%	-0.27%	-0.18	-0.18
1/14/2021	\$133.50	\$131.83	-	1.26%	0.00%	-0.39%	-0.43%	1.69%	1.12	1.12
1/15/2021	\$134.17	\$133.50	-	0.50%	-0.86%	-0.55%	-0.73%	1.23%	0.81	0.81
1/19/2021	\$137.96	\$134.17	-	2.79%	0.85%	1.31%	1.30%	1.49%	0.98	0.98
1/20/2021	\$142.68	\$137.96	-	3.36%	1.20%	1.81%	1.82%	1.55%	1.03	1.02
1/21/2021	\$142.60	\$142.68	-	-0.06%	-0.09%	-0.49%	-0.54%	0.48%	0.32	0.32
1/22/2021	\$143.34	\$142.60	-	0.52%	-0.15%	0.23%	0.12%	0.40%	0.26	0.26
1/25/2021	\$137.25	\$143.34	-	-4.34%	0.24%	-0.28%	-0.28%	-4.06%	-2.69 ***	-2.69 ***
1/26/2021	\$136.24	\$137.25	-	-0.74%	-0.29%	-0.73%	-0.80%	0.06%	0.04	0.04
1/27/2021	\$133.48	\$136.24	-	-2.05%	-2.51%	-2.18%	-2.53%	0.49%	0.32	0.32
1/28/2021	\$131.66	\$133.48	-	-1.37%	0.92%	1.94%	1.90%	-3.27%	-2.17 **	-2.16 **
1/29/2021	\$127.45	\$131.66	-	-3.25%	-1.78%	-1.64%	-1.91%	-1.34%	-0.89	-0.89
2/1/2021	\$129.07	\$127.45	-	1.26%	1.71%	2.36%	2.42%	-1.16%	-0.77	-0.77
2/2/2021	\$134.88	\$129.07	-	4.40%	1.39%	2.60%	2.59%	1.82%	1.20	1.20
2/3/2021	\$134.68	\$134.88	-	-0.15%	0.14%	-0.37%	-0.39%	0.24%	0.16	0.16
2/4/2021	\$138.37	\$134.68	-	2.70%	1.12%	1.82%	1.81%	0.89%	0.59	0.59
2/5/2021	\$139.98	\$138.37	-	1.16%	0.61%	1.19%	1.14%	0.02%	0.01	0.01
2/8/2021	\$142.79	\$139.98	-	1.99%	0.97%	0.33%	0.41%	1.58%	1.05	1.05
2/9/2021	\$144.00	\$142.79	-	0.84%	0.10%	0.89%	0.77%	0.07%	0.05	0.05
2/10/2021	\$142.54	\$144.00	-	-1.02%	-0.03%	-0.28%	-0.34%	-0.68%	-0.45	-0.45
2/11/2021	\$146.01	\$142.54	-	2.41%	0.19%	0.79%	0.69%	1.71%	1.14	1.13
2/12/2021	\$146.71	\$146.01	-	0.48%	0.47%	0.74%	0.70%	-0.22%	-0.15	-0.15
2/16/2021	\$146.01	\$146.71	-	-0.48%	-0.11%	-0.20%	-0.27%	-0.21%	-0.14	-0.14
2/17/2021	\$141.74	\$146.01	-	-2.97%	-0.23%	-1.15%	-1.18%	-1.79%	-1.19	-1.19
2/18/2021	\$143.11	\$141.74	-	0.96%	-0.66%	-0.29%	-0.46%	1.42%	0.94	0.94
2/19/2021	\$146.21	\$143.11	-	2.14%	0.27%	0.17%	0.14%	2.00%	1.33	1.33
2/22/2021	\$146.55	\$146.21	-	0.23%	-0.97%	-3.12%	-3.13%	3.36%	2.23 **	2.22 **
2/23/2021	\$140.98	\$146.55	-	-3.87%	-0.13%	-1.32%	-1.32%	-2.56%	-1.70 *	-1.69 *
2/24/2021	\$139.31	\$140.98	-	-1.19%	1.12%	1.09%	1.14%	-2.33%	-1.55	-1.54

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
2/25/2021	\$130.71	\$139.31	-	-6.37%	-2.70%	-4.01%	-4.26%	-2.11%	-1.40	-1.39
2/26/2021	\$132.35	\$130.71	-	1.25%	-0.39%	-0.04%	-0.18%	1.42%	0.94	0.94
3/1/2021	\$136.08	\$132.35	-	2.78%	2.45%	3.17%	3.30%	-0.52%	-0.35	-0.34
3/2/2021	\$130.45	\$136.08	-	-4.23%	-0.91%	-2.06%	-2.14%	-2.08%	-1.38	-1.38
3/3/2021	\$124.00	\$130.45	-	-5.07%	-1.48%	-4.17%	-4.20%	-0.87%	-0.58	-0.57
3/4/2021	\$118.46	\$124.00	-	-4.57%	-1.68%	-2.83%	-3.00%	-1.57%	-1.04	-1.04
3/5/2021	\$121.08	\$118.46	-	2.19%	1.72%	0.86%	1.04%	1.15%	0.76	0.76
3/8/2021	\$114.72	\$121.08	-	-5.40%	-0.59%	-2.90%	-2.86%	-2.53%	-1.68 *	-1.67 *
3/9/2021	\$119.00	\$114.72	-	3.66%	1.67%	4.41%	4.31%	-0.65%	-0.43	-0.43
3/10/2021	\$119.99	\$119.00	-	0.83%	0.68%	-0.56%	-0.47%	1.30%	0.86	0.86
3/11/2021	\$124.19	\$119.99	-	3.44%	1.41%	3.00%	2.96%	0.48%	0.32	0.32
3/12/2021	\$123.40	\$124.19	-	-0.64%	0.15%	-1.35%	-1.30%	0.66%	0.44	0.44
3/15/2021	\$122.63	\$123.40	-	-0.63%	0.70%	0.97%	0.95%	-1.58%	-1.05	-1.05
3/16/2021	\$121.76	\$122.63	-	-0.71%	-0.43%	-0.51%	-0.61%	-0.10%	-0.06	-0.06
3/17/2021	\$120.10	\$121.76	-	-1.37%	0.36%	-0.32%	-0.31%	-1.07%	-0.71	-0.71
3/18/2021	\$112.38	\$120.10	-	-6.64%	-1.81%	-3.68%	-3.80%	-2.84%	-1.88 *	-1.87 *
3/19/2021	\$116.49	\$112.38	-	3.59%	0.18%	1.04%	0.93%	2.66%	1.77 *	1.76 *
3/22/2021	\$117.76	\$116.49	-	1.08%	0.48%	1.56%	1.46%	-0.38%	-0.25	-0.25
3/23/2021	\$115.74	\$117.76	-	-1.73%	-1.21%	0.10%	-0.19%	-1.54%	-1.02	-1.02
3/24/2021	\$113.49	\$115.74	-	-1.96%	-0.91%	-2.72%	-2.75%	0.79%	0.52	0.52
3/25/2021	\$113.01	\$113.49	-	-0.42%	0.65%	-0.34%	-0.27%	-0.15%	-0.10	-0.10
3/26/2021	\$116.76	\$113.01	-	3.26%	1.52%	2.05%	2.10%	1.16%	0.77	0.77
3/29/2021	\$112.53	\$116.76	-	-3.69%	-0.53%	-1.08%	-1.16%	-2.53%	-1.67 *	-1.67 *
3/30/2021	\$112.55	\$112.53	-	0.02%	0.00%	-0.37%	-0.41%	0.43%	0.29	0.29
3/31/2021	\$114.34	\$112.55	\$0.03	1.60%	0.56%	2.24%	2.11%	-0.50%	-0.33	-0.33
4/1/2021	\$117.99	\$114.34	-	3.14%	1.27%	2.43%	2.41%	0.73%	0.49	0.48
4/5/2021	\$117.91	\$117.99	-	-0.07%	1.14%	1.11%	1.16%	-1.23%	-0.81	-0.81
4/6/2021	\$120.04	\$117.91	-	1.79%	0.03%	0.42%	0.32%	1.47%	0.97	0.97
4/7/2021	\$118.26	\$120.04	-	-1.49%	-0.15%	-0.36%	-0.43%	-1.06%	-0.70	-0.70
4/8/2021	\$120.62	\$118.26	-	1.98%	0.59%	1.96%	1.85%	0.12%	0.08	0.08
4/9/2021	\$123.52	\$120.62	-	2.38%	0.55%	0.67%	0.65%	1.73%	1.14	1.14
4/12/2021	\$124.65	\$123.52	-	0.91%	-0.07%	0.29%	0.18%	0.73%	0.48	0.48
4/13/2021	\$128.78	\$124.65	-	3.26%	0.39%	1.76%	1.63%	1.63%	1.08	1.08
4/14/2021	\$127.86	\$128.78	-	-0.72%	-0.29%	-1.15%	-1.18%	0.47%	0.31	0.31
4/15/2021	\$131.71	\$127.86	-	2.97%	1.00%	1.87%	1.84%	1.13%	0.75	0.74

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
4/16/2021	\$129.89	\$131.71	-	-1.39%	0.26%	-0.47%	-0.46%	-0.93%	-0.62	-0.62
4/19/2021	\$128.59	\$129.89	-	-1.01%	-0.70%	-1.61%	-1.68%	0.68%	0.45	0.45
4/20/2021	\$126.77	\$128.59	-	-1.43%	-0.91%	-0.90%	-1.07%	-0.35%	-0.24	-0.23
4/21/2021	\$127.73	\$126.77	-	0.75%	1.12%	0.52%	0.61%	0.15%	0.10	0.10
4/22/2021	\$129.33	\$127.73	-	1.24%	-0.73%	-0.10%	-0.29%	1.54%	1.02	1.02
4/23/2021	\$130.79	\$129.33	-	1.12%	1.20%	1.42%	1.46%	-0.34%	-0.22	-0.22
4/26/2021	\$131.01	\$130.79	-	0.17%	0.44%	1.25%	1.17%	-1.00%	-0.66	-0.66
4/27/2021	\$129.30	\$131.01	-	-1.31%	-0.02%	-0.42%	-0.47%	-0.85%	-0.56	-0.56
4/28/2021	\$128.67	\$129.30	-	-0.49%	0.01%	-0.33%	-0.38%	-0.11%	-0.07	-0.07
4/29/2021	\$126.97	\$128.67	-	-1.33%	0.35%	-1.68%	-1.56%	0.23%	0.16	0.15
4/30/2021	\$126.94	\$126.97	-	-0.02%	-0.80%	-1.05%	-1.18%	1.16%	0.77	0.77
5/3/2021	\$124.06	\$126.94	-	-2.29%	0.20%	-1.31%	-1.24%	-1.05%	-0.70	-0.69
5/4/2021	\$121.29	\$124.06	-	-2.26%	-0.85%	-2.34%	-2.39%	0.13%	0.09	0.09
5/5/2021	\$118.06	\$121.29	-	-2.70%	-0.01%	-0.87%	-0.88%	-1.82%	-1.20	-1.20
5/6/2021	\$118.44	\$118.06	-	0.32%	0.48%	-0.64%	-0.58%	0.90%	0.60	0.60
5/7/2021	\$120.22	\$118.44	-	1.49%	0.86%	0.92%	0.93%	0.56%	0.37	0.37
5/10/2021	\$118.40	\$120.22	-	-1.53%	-1.24%	-2.36%	-2.48%	0.95%	0.63	0.63
5/11/2021	\$120.03	\$118.40	-	1.37%	-0.66%	1.06%	0.80%	0.57%	0.38	0.38
5/12/2021	\$116.64	\$120.03	-	-2.86%	-2.28%	-2.48%	-2.78%	-0.09%	-0.06	-0.06
5/13/2021	\$118.28	\$116.64	-	1.40%	0.97%	-0.09%	0.01%	1.38%	0.92	0.91
5/14/2021	\$120.35	\$118.28	-	1.73%	1.74%	2.80%	2.84%	-1.10%	-0.73	-0.73
5/17/2021	\$116.77	\$120.35	-	-3.02%	-0.14%	-0.82%	-0.86%	-2.16%	-1.43	-1.43
5/18/2021	\$118.52	\$116.77	-	1.49%	-0.60%	0.12%	-0.06%	1.55%	1.03	1.03
5/19/2021	\$117.86	\$118.52	-	-0.56%	-0.38%	0.36%	0.20%	-0.75%	-0.50	-0.50
5/20/2021	\$120.73	\$117.86	-	2.41%	1.11%	2.27%	2.24%	0.17%	0.11	0.11
5/21/2021	\$120.91	\$120.73	-	0.15%	-0.03%	-0.27%	-0.32%	0.47%	0.31	0.31
5/24/2021	\$122.02	\$120.91	-	0.91%	0.93%	1.59%	1.57%	-0.66%	-0.44	-0.43
5/25/2021	\$121.65	\$122.02	-	-0.30%	-0.27%	0.23%	0.10%	-0.40%	-0.26	-0.26
5/26/2021	\$120.68	\$121.65	-	-0.80%	0.45%	0.86%	0.81%	-1.61%	-1.07	-1.07
5/27/2021	\$120.24	\$120.68	-	-0.37%	0.29%	-0.70%	-0.67%	0.30%	0.20	0.20
5/28/2021	\$118.14	\$120.24	-	-1.76%	0.10%	0.70%	0.60%	-2.36%	-1.56	-1.56
6/1/2021	\$118.00	\$118.14	-	-0.12%	0.17%	-0.59%	-0.59%	0.47%	0.31	0.31
6/2/2021	\$117.68	\$118.00	-	-0.27%	0.17%	0.21%	0.16%	-0.43%	-0.28	-0.28
6/3/2021	\$116.02	\$117.68	-	-1.42%	-0.52%	-1.10%	-1.19%	-0.23%	-0.16	-0.15
6/4/2021	\$119.85	\$116.02	-	3.25%	0.84%	2.16%	2.08%	1.17%	0.77	0.77

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
6/7/2021	\$123.92	\$119.85	-	3.34%	0.16%	0.79%	0.69%	2.64%	1.75 *	1.75 *
6/8/2021	\$127.92	\$123.92	-	3.18%	0.18%	0.41%	0.34%	2.83%	1.88 *	1.88 *
6/9/2021	\$127.27	\$127.92	-	-0.51%	-0.29%	-0.10%	-0.21%	-0.30%	-0.20	-0.20
6/10/2021	\$128.56	\$127.27	-	1.01%	0.40%	1.81%	1.68%	-0.67%	-0.45	-0.44
6/11/2021	\$131.29	\$128.56	-	2.10%	0.31%	1.05%	0.96%	1.14%	0.76	0.76
6/14/2021	\$134.96	\$131.29	-	2.76%	0.13%	1.18%	1.05%	1.71%	1.13	1.13
6/15/2021	\$133.54	\$134.96	-	-1.06%	-0.30%	-1.30%	-1.33%	0.27%	0.18	0.18
6/16/2021	\$132.84	\$133.54	-	-0.53%	-0.47%	-0.36%	-0.49%	-0.04%	-0.02	-0.02
6/17/2021	\$136.44	\$132.84	-	2.67%	-0.14%	1.90%	1.67%	1.00%	0.67	0.66
6/18/2021	\$137.15	\$136.44	-	0.52%	-1.26%	0.25%	-0.07%	0.58%	0.39	0.39
6/21/2021	\$137.58	\$137.15	-	0.31%	1.35%	0.46%	0.59%	-0.28%	-0.18	-0.18
6/22/2021	\$138.35	\$137.58	-	0.56%	0.49%	1.23%	1.15%	-0.60%	-0.40	-0.39
6/23/2021	\$139.40	\$138.35	-	0.76%	-0.01%	-0.04%	-0.11%	0.86%	0.57	0.57
6/24/2021	\$139.54	\$139.40	-	0.10%	0.65%	0.82%	0.81%	-0.71%	-0.47	-0.47
6/25/2021	\$140.37	\$139.54	-	0.59%	0.32%	0.06%	0.04%	0.55%	0.37	0.37
6/28/2021	\$140.65	\$140.37	-	0.20%	0.11%	1.22%	1.08%	-0.88%	-0.58	-0.58
6/29/2021	\$141.92	\$140.65	-	0.90%	0.00%	0.47%	0.36%	0.54%	0.36	0.36
6/30/2021	\$139.19	\$141.92	\$0.03	-1.92%	0.04%	-1.35%	-1.32%	-0.60%	-0.40	-0.40
7/1/2021	\$138.33	\$139.19	-	-0.62%	0.42%	0.15%	0.14%	-0.76%	-0.50	-0.50
7/2/2021	\$139.97	\$138.33	-	1.18%	0.50%	1.20%	1.13%	0.05%	0.03	0.03
7/6/2021	\$140.06	\$139.97	-	0.06%	-0.30%	1.17%	0.96%	-0.90%	-0.59	-0.59
7/7/2021	\$138.78	\$140.06	-	-0.92%	0.11%	0.28%	0.21%	-1.12%	-0.75	-0.74
7/8/2021	\$137.53	\$138.78	-	-0.90%	-0.90%	-0.78%	-0.95%	0.05%	0.03	0.03
7/9/2021	\$137.52	\$137.53	-	-0.01%	1.28%	0.59%	0.70%	-0.71%	-0.47	-0.47
7/12/2021	\$136.25	\$137.52	-	-0.93%	0.22%	-0.86%	-0.83%	-0.10%	-0.06	-0.06
7/13/2021	\$135.66	\$136.25	-	-0.43%	-0.60%	-0.10%	-0.27%	-0.16%	-0.11	-0.11
7/14/2021	\$133.20	\$135.66	-	-1.83%	-0.24%	-0.66%	-0.72%	-1.11%	-0.73	-0.73
7/15/2021	\$131.38	\$133.20	-	-1.38%	-0.39%	-1.10%	-1.16%	-0.22%	-0.14	-0.14
7/16/2021	\$132.47	\$131.38	-	0.83%	-0.76%	0.17%	-0.05%	0.87%	0.58	0.58
7/19/2021	\$131.83	\$132.47	-	-0.48%	-1.47%	-0.43%	-0.73%	0.24%	0.16	0.16
7/20/2021	\$135.08	\$131.83	-	2.44%	1.68%	1.87%	1.97%	0.47%	0.31	0.31
7/21/2021	\$135.97	\$135.08	-	0.66%	0.96%	0.81%	0.85%	-0.19%	-0.13	-0.13
7/22/2021	\$136.00	\$135.97	-	0.02%	0.03%	1.43%	1.26%	-1.24%	-0.82	-0.82
7/23/2021	\$136.80	\$136.00	-	0.59%	0.89%	0.72%	0.76%	-0.17%	-0.11	-0.11
7/26/2021	\$136.64	\$136.80	-	-0.12%	0.16%	-0.08%	-0.12%	0.00%	0.00	0.00

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
7/27/2021	\$133.99	\$136.64	-	-1.96%	-0.60%	-1.13%	-1.23%	-0.73%	-0.48	-0.48
7/28/2021	\$136.89	\$133.99	-	2.14%	0.30%	0.73%	0.66%	1.49%	0.98	0.98
7/29/2021	\$127.35	\$136.89	-	-7.22%	0.45%	0.20%	0.19%	-7.42%	-4.92 ***	-4.91 ***
7/30/2021	\$127.64	\$127.35	-	0.23%	-0.56%	-0.42%	-0.56%	0.79%	0.52	0.52
8/2/2021	\$127.01	\$127.64	-	-0.49%	-0.14%	0.02%	-0.08%	-0.42%	-0.28	-0.28
8/3/2021	\$126.99	\$127.01	-	-0.02%	0.68%	0.44%	0.45%	-0.47%	-0.31	-0.31
8/4/2021	\$126.75	\$126.99	-	-0.19%	-0.40%	1.05%	0.83%	-1.02%	-0.68	-0.68
8/5/2021	\$127.50	\$126.75	-	0.59%	0.71%	0.94%	0.93%	-0.34%	-0.23	-0.23
8/6/2021	\$128.60	\$127.50	-	0.86%	0.08%	-0.44%	-0.47%	1.32%	0.88	0.88
8/9/2021	\$128.86	\$128.60	-	0.20%	-0.04%	-0.03%	-0.11%	0.31%	0.20	0.20
8/10/2021	\$127.26	\$128.86	-	-1.25%	0.07%	-1.26%	-1.23%	-0.02%	-0.01	-0.01
8/11/2021	\$126.48	\$127.26	-	-0.61%	0.24%	-0.43%	-0.42%	-0.19%	-0.13	-0.13
8/12/2021	\$126.54	\$126.48	-	0.05%	0.20%	1.15%	1.04%	-0.99%	-0.65	-0.65
8/13/2021	\$127.31	\$126.54	-	0.61%	0.03%	0.28%	0.20%	0.41%	0.27	0.27
8/16/2021	\$127.50	\$127.31	-	0.15%	-0.08%	-0.79%	-0.82%	0.97%	0.64	0.64
8/17/2021	\$129.42	\$127.50	-	1.49%	-0.79%	-0.70%	-0.86%	2.35%	1.56	1.56
8/18/2021	\$130.52	\$129.42	-	0.85%	-0.89%	-0.46%	-0.65%	1.50%	0.99	0.99
8/19/2021	\$129.71	\$130.52	-	-0.62%	-0.23%	0.70%	0.53%	-1.16%	-0.77	-0.77
8/20/2021	\$131.54	\$129.71	-	1.40%	0.86%	1.25%	1.24%	0.16%	0.11	0.10
8/23/2021	\$132.51	\$131.54	-	0.73%	1.05%	1.53%	1.54%	-0.80%	-0.53	-0.53
8/24/2021	\$133.24	\$132.51	-	0.55%	0.42%	0.87%	0.82%	-0.27%	-0.18	-0.18
8/25/2021	\$133.93	\$133.24	-	0.52%	0.26%	0.24%	0.20%	0.32%	0.21	0.21
8/26/2021	\$134.57	\$133.93	-	0.48%	-0.65%	-0.34%	-0.50%	0.97%	0.65	0.65
8/27/2021	\$138.00	\$134.57	-	2.52%	1.09%	1.56%	1.57%	0.94%	0.63	0.63
8/30/2021	\$138.39	\$138.00	-	0.28%	0.30%	0.51%	0.45%	-0.17%	-0.11	-0.11
8/31/2021	\$137.63	\$138.39	-	-0.55%	-0.11%	-0.88%	-0.91%	0.36%	0.24	0.24
9/1/2021	\$141.10	\$137.63	-	2.49%	0.20%	0.41%	0.35%	2.14%	1.42	1.42
9/2/2021	\$141.01	\$141.10	-	-0.06%	0.41%	0.04%	0.04%	-0.11%	-0.07	-0.07
9/3/2021	\$142.39	\$141.01	-	0.97%	-0.01%	0.97%	0.82%	0.15%	0.10	0.10
9/7/2021	\$139.84	\$142.39	-	-1.81%	-0.42%	-1.10%	-1.17%	-0.64%	-0.42	-0.42
9/8/2021	\$137.59	\$139.84	-	-1.62%	-0.35%	-0.57%	-0.66%	-0.96%	-0.64	-0.64
9/9/2021	\$136.65	\$137.59	-	-0.69%	-0.29%	-0.15%	-0.26%	-0.42%	-0.28	-0.28
9/10/2021	\$133.31	\$136.65	-	-2.47%	-0.73%	-0.76%	-0.90%	-1.57%	-1.04	-1.04
9/13/2021	\$132.47	\$133.31	-	-0.63%	0.20%	-1.10%	-1.05%	0.42%	0.28	0.28
9/14/2021	\$130.17	\$132.47	-	-1.75%	-0.62%	0.07%	-0.11%	-1.64%	-1.09	-1.08

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
9/15/2021	\$132.26	\$130.17	-	1.59%	0.85%	1.13%	1.13%	0.47%	0.31	0.31
9/16/2021	\$131.96	\$132.26	-	-0.23%	-0.09%	0.76%	0.62%	-0.85%	-0.56	-0.56
9/17/2021	\$131.93	\$131.96	-	-0.02%	-0.74%	-0.86%	-1.00%	0.98%	0.65	0.65
9/20/2021	\$129.44	\$131.93	-	-1.91%	-1.84%	-1.66%	-1.94%	0.03%	0.02	0.02
9/21/2021	\$129.94	\$129.44	-	0.39%	0.09%	0.25%	0.18%	0.21%	0.14	0.14
9/22/2021	\$132.90	\$129.94	-	2.25%	0.99%	0.96%	1.00%	1.26%	0.83	0.83
9/23/2021	\$134.95	\$132.90	-	1.53%	1.20%	1.70%	1.72%	-0.19%	-0.12	-0.12
9/24/2021	\$132.73	\$134.95	-	-1.66%	-0.01%	0.10%	0.02%	-1.68%	-1.11	-1.11
9/27/2021	\$132.35	\$132.73	-	-0.29%	-0.10%	-1.78%	-1.74%	1.45%	0.96	0.96
9/28/2021	\$129.18	\$132.35	-	-2.42%	-2.10%	-3.79%	-3.96%	1.53%	1.02	1.01
9/29/2021	\$127.58	\$129.18	-	-1.25%	-0.01%	-0.28%	-0.33%	-0.92%	-0.61	-0.61
9/30/2021	\$127.10	\$127.58	\$0.03	-0.35%	-0.95%	-0.21%	-0.43%	0.08%	0.05	0.05
10/1/2021	\$128.61	\$127.10	-	1.18%	1.06%	1.48%	1.49%	-0.31%	-0.21	-0.20
10/4/2021	\$123.00	\$128.61	-	-4.46%	-1.30%	-3.02%	-3.10%	-1.36%	-0.90	-0.90
10/5/2021	\$124.56	\$123.00	-	1.26%	0.95%	1.59%	1.57%	-0.31%	-0.21	-0.20
10/6/2021	\$124.63	\$124.56	-	0.06%	0.28%	0.83%	0.75%	-0.69%	-0.46	-0.46
10/7/2021	\$126.45	\$124.63	-	1.45%	0.99%	1.18%	1.20%	0.25%	0.17	0.17
10/8/2021	\$124.46	\$126.45	-	-1.59%	-0.25%	-0.74%	-0.80%	-0.78%	-0.52	-0.52
10/11/2021	\$122.34	\$124.46	-	-1.72%	-0.64%	-0.18%	-0.35%	-1.36%	-0.90	-0.90
10/12/2021	\$124.09	\$122.34	-	1.42%	0.02%	1.22%	1.07%	0.35%	0.23	0.23
10/13/2021	\$126.05	\$124.09	-	1.57%	0.48%	2.20%	2.05%	-0.48%	-0.32	-0.32
10/14/2021	\$130.47	\$126.05	-	3.45%	1.58%	1.62%	1.71%	1.73%	1.15	1.15
10/15/2021	\$129.37	\$130.47	-	-0.85%	0.57%	0.27%	0.28%	-1.13%	-0.75	-0.75
10/18/2021	\$129.14	\$129.37	-	-0.18%	0.33%	1.29%	1.19%	-1.36%	-0.90	-0.90
10/19/2021	\$130.71	\$129.14	-	1.21%	0.68%	0.82%	0.81%	0.40%	0.26	0.26
10/20/2021	\$130.51	\$130.71	-	-0.15%	0.39%	-0.18%	-0.17%	0.01%	0.01	0.01
10/21/2021	\$130.63	\$130.51	-	0.09%	0.29%	1.03%	0.93%	-0.84%	-0.56	-0.56
10/22/2021	\$128.61	\$130.63	-	-1.56%	-0.17%	0.14%	0.03%	-1.59%	-1.05	-1.05
10/25/2021	\$128.07	\$128.61	-	-0.42%	0.55%	0.51%	0.50%	-0.92%	-0.61	-0.61
10/26/2021	\$127.93	\$128.07	-	-0.11%	-0.01%	-0.30%	-0.35%	0.24%	0.16	0.16
10/27/2021	\$124.46	\$127.93	-	-2.75%	-0.76%	-0.79%	-0.93%	-1.82%	-1.20	-1.20
10/28/2021	\$118.31	\$124.46	-	-5.07%	1.12%	1.21%	1.25%	-6.32%	-4.19 ***	-4.18 ***
10/29/2021	\$118.72	\$118.31	-	0.35%	0.10%	0.98%	0.85%	-0.51%	-0.33	-0.33
11/1/2021	\$119.80	\$118.72	-	0.91%	0.57%	-0.44%	-0.38%	1.29%	0.85	0.85
11/2/2021	\$122.58	\$119.80	-	2.29%	0.20%	0.30%	0.24%	2.05%	1.36	1.36



**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
11/3/2021	\$121.80	\$122.58	-	-0.64%	0.73%	0.21%	0.25%	-0.89%	-0.59	-0.59
11/4/2021	\$120.61	\$121.80	-	-0.98%	0.29%	0.95%	0.86%	-1.85%	-1.22	-1.22
11/5/2021	\$120.11	\$120.61	-	-0.42%	0.40%	-0.83%	-0.77%	0.35%	0.23	0.23
11/8/2021	\$120.46	\$120.11	-	0.29%	0.20%	1.40%	1.26%	-0.97%	-0.65	-0.64
11/9/2021	\$121.09	\$120.46	-	0.52%	-0.29%	0.35%	0.20%	0.32%	0.21	0.21
11/10/2021	\$117.12	\$121.09	-	-3.33%	-1.05%	-2.90%	-2.95%	-0.38%	-0.25	-0.25
11/11/2021	\$117.41	\$117.12	-	0.25%	0.24%	0.37%	0.32%	-0.07%	-0.05	-0.05
11/12/2021	\$118.77	\$117.41	-	1.15%	0.71%	1.65%	1.59%	-0.44%	-0.29	-0.29
11/15/2021	\$118.45	\$118.77	-	-0.27%	-0.03%	-0.62%	-0.65%	0.38%	0.25	0.25
11/16/2021	\$120.54	\$118.45	-	1.75%	0.40%	1.37%	1.28%	0.47%	0.31	0.31
11/17/2021	\$117.33	\$120.54	-	-2.70%	-0.45%	-0.79%	-0.88%	-1.81%	-1.20	-1.20
11/18/2021	\$118.00	\$117.33	-	0.57%	0.03%	-0.85%	-0.85%	1.42%	0.94	0.94
11/19/2021	\$119.94	\$118.00	-	1.63%	-0.29%	0.54%	0.38%	1.25%	0.83	0.83
11/22/2021	\$119.34	\$119.94	-	-0.50%	-0.62%	-2.99%	-2.96%	2.45%	1.63	1.62
11/23/2021	\$117.04	\$119.34	-	-1.95%	-0.03%	-1.68%	-1.64%	-0.31%	-0.21	-0.20
11/24/2021	\$117.61	\$117.04	-	0.49%	0.32%	0.63%	0.57%	-0.08%	-0.05	-0.05
11/26/2021	\$114.85	\$117.61	-	-2.37%	-2.26%	-1.19%	-1.57%	-0.80%	-0.53	-0.53
11/29/2021	\$117.24	\$114.85	-	2.06%	1.00%	2.24%	2.19%	-0.13%	-0.08	-0.08
11/30/2021	\$114.82	\$117.24	-	-2.09%	-1.93%	-2.91%	-3.12%	1.03%	0.68	0.68
12/1/2021	\$109.36	\$114.82	-	-4.87%	-1.52%	-4.41%	-4.43%	-0.44%	-0.29	-0.29
12/2/2021	\$110.74	\$109.36	-	1.25%	1.53%	1.92%	1.99%	-0.73%	-0.49	-0.48
12/3/2021	\$109.49	\$110.74	-	-1.14%	-1.14%	-3.90%	-3.89%	2.75%	1.82 *	1.81 *
12/6/2021	\$110.58	\$109.49	-	0.99%	1.17%	0.12%	0.25%	0.74%	0.49	0.49
12/7/2021	\$112.94	\$110.58	-	2.11%	2.13%	3.85%	3.88%	-1.77%	-1.17	-1.17
12/8/2021	\$115.33	\$112.94	-	2.09%	0.43%	0.91%	0.85%	1.25%	0.83	0.83
12/9/2021	\$112.98	\$115.33	-	-2.06%	-1.08%	-2.36%	-2.45%	0.39%	0.26	0.26
12/10/2021	\$113.40	\$112.98	-	0.37%	0.61%	1.53%	1.45%	-1.08%	-0.72	-0.72
12/13/2021	\$115.87	\$113.40	-	2.15%	-0.99%	-0.28%	-0.51%	2.66%	1.76 *	1.76 *
12/14/2021	\$111.73	\$115.87	-	-3.64%	-0.77%	-3.34%	-3.31%	-0.33%	-0.22	-0.22
12/15/2021	\$108.49	\$111.73	-	-2.94%	1.49%	2.72%	2.72%	-5.66%	-3.75 ***	-3.74 ***
12/16/2021	\$104.20	\$108.49	-	-4.03%	-1.01%	-3.42%	-3.42%	-0.62%	-0.41	-0.41
12/17/2021	\$105.10	\$104.20	-	0.86%	-0.63%	0.42%	0.21%	0.65%	0.43	0.43
12/20/2021	\$101.24	\$105.10	-	-3.74%	-1.24%	-1.76%	-1.93%	-1.82%	-1.20	-1.20
12/21/2021	\$108.04	\$101.24	-	6.50%	1.97%	2.81%	2.89%	3.62%	2.40 **	2.39 **
12/22/2021	\$109.45	\$108.04	-	1.30%	0.95%	0.67%	0.72%	0.58%	0.38	0.38

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
12/23/2021	\$110.46	\$109.45	-	0.92%	0.68%	0.49%	0.50%	0.42%	0.28	0.28
12/27/2021	\$112.69	\$110.46	-	2.00%	1.20%	1.34%	1.38%	0.62%	0.41	0.41
12/28/2021	\$111.95	\$112.69	-	-0.66%	-0.24%	-1.10%	-1.13%	0.48%	0.32	0.31
12/29/2021	\$112.96	\$111.95	-	0.90%	0.06%	-0.19%	-0.23%	1.13%	0.75	0.75
12/30/2021	\$113.79	\$112.96	-	0.73%	-0.10%	0.19%	0.09%	0.64%	0.42	0.42
12/31/2021	\$111.82	\$113.79	\$0.03	-1.72%	-0.24%	-0.95%	-0.99%	-0.73%	-0.48	-0.48
1/3/2022	\$110.25	\$111.82	-	-1.41%	0.61%	-1.08%	-0.96%	-0.45%	-0.30	-0.30
1/4/2022	\$109.42	\$110.25	-	-0.76%	-0.24%	-2.39%	-2.33%	1.57%	1.04	1.04
1/5/2022	\$97.26	\$109.42	-	-11.78%	-2.21%	-5.10%	-5.19%	-6.59%	-4.37 ***	-4.33 ***
1/6/2022	\$99.95	\$97.26	-	2.73%	0.02%	0.20%	0.12%	2.61%	1.73 *	1.73 *
1/7/2022	\$99.21	\$99.95	-	-0.74%	-0.42%	-0.91%	-0.98%	0.24%	0.16	0.16
1/10/2022	\$98.69	\$99.21	-	-0.53%	-0.19%	1.07%	0.88%	-1.41%	-0.93	-0.93
1/11/2022	\$104.07	\$98.69	-	5.31%	1.08%	1.62%	1.62%	3.69%	2.44 **	2.44 **
1/12/2022	\$103.04	\$104.07	-	-0.99%	0.18%	-0.38%	-0.39%	-0.61%	-0.40	-0.40
1/13/2022	\$99.02	\$103.04	-	-3.98%	-1.45%	-4.34%	-4.35%	0.37%	0.25	0.25
1/14/2022	\$99.53	\$99.02	-	0.51%	0.02%	0.33%	0.24%	0.28%	0.18	0.18
1/18/2022	\$96.25	\$99.53	-	-3.35%	-1.95%	-2.45%	-2.69%	-0.66%	-0.44	-0.44
1/19/2022	\$96.47	\$96.25	-	0.23%	-0.94%	-0.07%	-0.30%	0.53%	0.35	0.35
1/20/2022	\$96.51	\$96.47	-	0.04%	-1.11%	-0.74%	-0.95%	1.00%	0.66	0.66
1/21/2022	\$92.06	\$96.51	-	-4.72%	-2.01%	-2.88%	-3.10%	-1.62%	-1.07	-1.07
1/24/2022	\$97.35	\$92.06	-	5.59%	0.42%	2.36%	2.20%	3.39%	2.25 **	2.24 **
1/25/2022	\$95.32	\$97.35	-	-2.11%	-1.25%	-4.08%	-4.08%	1.97%	1.31	1.30
1/26/2022	\$92.83	\$95.32	-	-2.65%	-0.36%	-0.89%	-0.96%	-1.69%	-1.12	-1.12
1/27/2022	\$91.50	\$92.83	-	-1.44%	-0.81%	-0.01%	-0.22%	-1.22%	-0.81	-0.81
1/28/2022	\$95.52	\$91.50	-	4.30%	2.22%	3.99%	4.02%	0.28%	0.19	0.18
1/31/2022	\$99.22	\$95.52	-	3.80%	2.22%	4.10%	4.12%	-0.32%	-0.21	-0.21
2/1/2022	\$101.42	\$99.22	-	2.19%	0.85%	0.43%	0.48%	1.71%	1.13	1.13
2/2/2022	\$99.95	\$101.42	-	-1.46%	0.47%	-1.15%	-1.05%	-0.41%	-0.27	-0.27
2/3/2022	\$97.44	\$99.95	-	-2.54%	-2.36%	-3.97%	-4.17%	1.63%	1.08	1.07
2/4/2022	\$97.88	\$97.44	-	0.45%	0.72%	2.79%	2.65%	-2.20%	-1.46	-1.45
2/7/2022	\$98.27	\$97.88	-	0.40%	-0.18%	-0.52%	-0.59%	0.98%	0.65	0.65
2/8/2022	\$98.39	\$98.27	-	0.12%	0.91%	1.31%	1.31%	-1.19%	-0.79	-0.79
2/9/2022	\$101.91	\$98.39	-	3.52%	1.61%	3.22%	3.20%	0.31%	0.21	0.21
2/10/2022	\$98.81	\$101.91	-	-3.09%	-1.64%	-1.75%	-1.99%	-1.10%	-0.73	-0.73
2/11/2022	\$97.57	\$98.81	-	-1.26%	-1.78%	-3.62%	-3.75%	2.48%	1.65 *	1.64

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
2/14/2022	\$97.47	\$97.57	-	-0.10%	-0.41%	-0.29%	-0.41%	0.31%	0.20	0.20
2/15/2022	\$101.00	\$97.47	-	3.56%	1.75%	2.22%	2.30%	1.26%	0.83	0.83
2/16/2022	\$97.52	\$101.00	-	-3.51%	0.03%	-0.77%	-0.78%	-2.73%	-1.81 *	-1.81 *
2/17/2022	\$82.28	\$97.52	-	-16.99%	-2.15%	-4.78%	-4.88%	-12.11%	-8.03 ***	-7.96 ***
2/18/2022	\$82.38	\$82.28	-	0.12%	-0.83%	-2.28%	-2.33%	2.45%	1.62	1.62
2/22/2022	\$79.66	\$82.38	-	-3.36%	-1.13%	-0.76%	-0.98%	-2.38%	-1.58	-1.57
2/23/2022	\$77.54	\$79.66	-	-2.70%	-1.82%	-2.73%	-2.92%	0.22%	0.15	0.15
2/24/2022	\$81.22	\$77.54	-	4.64%	1.60%	6.36%	6.11%	-1.47%	-0.98	-0.96
2/25/2022	\$84.72	\$81.22	-	4.22%	2.19%	0.73%	1.00%	3.22%	2.13 **	2.12 **
2/28/2022	\$87.12	\$84.72	-	2.79%	-0.04%	1.01%	0.86%	1.93%	1.28	1.28
3/1/2022	\$85.40	\$87.12	-	-1.99%	-1.51%	-0.84%	-1.12%	-0.88%	-0.58	-0.58
3/2/2022	\$85.99	\$85.40	-	0.69%	1.76%	1.69%	1.81%	-1.12%	-0.74	-0.74
3/3/2022	\$83.13	\$85.99	-	-3.38%	-0.81%	-2.71%	-2.72%	-0.66%	-0.44	-0.44
3/4/2022	\$82.21	\$83.13	-	-1.11%	-1.02%	-2.20%	-2.29%	1.18%	0.78	0.78
3/7/2022	\$79.28	\$82.21	-	-3.63%	-2.96%	-4.51%	-4.78%	1.15%	0.76	0.76
3/8/2022	\$77.20	\$79.28	-	-2.66%	-0.44%	-1.18%	-1.24%	-1.42%	-0.94	-0.94
3/9/2022	\$80.23	\$77.20	-	3.85%	2.59%	4.92%	4.96%	-1.11%	-0.73	-0.73
3/10/2022	\$78.68	\$80.23	-	-1.95%	-0.42%	-1.54%	-1.57%	-0.38%	-0.25	-0.25
3/11/2022	\$73.13	\$78.68	-	-7.32%	-1.38%	-3.19%	-3.28%	-4.04%	-2.68 ***	-2.67 ***
3/14/2022	\$72.27	\$73.13	-	-1.18%	-1.06%	-2.91%	-2.96%	1.77%	1.17	1.17
3/15/2022	\$73.54	\$72.27	-	1.74%	1.89%	2.63%	2.70%	-0.96%	-0.64	-0.63
3/16/2022	\$75.86	\$73.54	-	3.11%	2.51%	4.20%	4.27%	-1.17%	-0.77	-0.77
3/17/2022	\$78.00	\$75.86	-	2.78%	1.38%	2.44%	2.44%	0.34%	0.23	0.23
3/18/2022	\$79.57	\$78.00	-	1.99%	1.22%	2.94%	2.87%	-0.88%	-0.58	-0.58
3/21/2022	\$79.02	\$79.57	-	-0.69%	-0.17%	-0.92%	-0.95%	0.26%	0.17	0.17
3/22/2022	\$82.31	\$79.02	-	4.08%	1.17%	2.50%	2.45%	1.63%	1.08	1.08
3/23/2022	\$79.52	\$82.31	-	-3.45%	-1.19%	-2.52%	-2.62%	-0.83%	-0.55	-0.55
3/24/2022	\$79.61	\$79.52	-	0.11%	1.30%	1.81%	1.84%	-1.73%	-1.14	-1.14
3/25/2022	\$77.82	\$79.61	-	-2.27%	0.31%	-1.46%	-1.37%	-0.91%	-0.60	-0.60
3/28/2022	\$79.82	\$77.82	-	2.54%	0.61%	2.39%	2.25%	0.28%	0.19	0.19
3/29/2022	\$82.71	\$79.82	-	3.56%	1.46%	2.47%	2.48%	1.08%	0.71	0.71
3/30/2022	\$80.80	\$82.71	-	-2.34%	-0.77%	-2.00%	-2.06%	-0.28%	-0.18	-0.18
3/31/2022	\$80.65	\$80.80	\$0.03	-0.15%	-1.46%	-0.97%	-1.23%	1.09%	0.72	0.72
4/1/2022	\$80.24	\$80.65	-	-0.51%	0.45%	0.33%	0.31%	-0.82%	-0.54	-0.54
4/4/2022	\$81.45	\$80.24	-	1.50%	0.83%	2.51%	2.41%	-0.91%	-0.60	-0.60

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
4/5/2022	\$78.25	\$81.45	-	-4.01%	-1.49%	-2.67%	-2.81%	-1.20%	-0.79	-0.79
4/6/2022	\$74.94	\$78.25	-	-4.32%	-1.13%	-3.20%	-3.23%	-1.09%	-0.72	-0.72
4/7/2022	\$75.85	\$74.94	-	1.21%	0.25%	0.49%	0.43%	0.77%	0.51	0.51
4/8/2022	\$73.78	\$75.85	-	-2.77%	-0.32%	-1.66%	-1.67%	-1.10%	-0.73	-0.73
4/11/2022	\$75.74	\$73.78	-	2.62%	-1.45%	-1.06%	-1.31%	3.93%	2.61 ***	2.60 ***
4/12/2022	\$76.00	\$75.74	-	0.34%	-0.27%	-0.70%	-0.77%	1.11%	0.74	0.74
4/13/2022	\$76.76	\$76.00	-	1.00%	1.33%	2.27%	2.27%	-1.28%	-0.85	-0.84
4/14/2022	\$74.51	\$76.76	-	-2.98%	-1.18%	-2.56%	-2.65%	-0.32%	-0.21	-0.21
4/18/2022	\$74.11	\$74.51	-	-0.54%	-0.21%	-1.07%	-1.10%	0.57%	0.38	0.37
4/19/2022	\$75.73	\$74.11	-	2.16%	1.62%	2.78%	2.79%	-0.63%	-0.42	-0.42
4/20/2022	\$74.42	\$75.73	-	-1.74%	-0.09%	-1.41%	-1.39%	-0.35%	-0.23	-0.23
4/21/2022	\$72.44	\$74.42	-	-2.70%	-1.70%	-3.35%	-3.48%	0.78%	0.52	0.52
4/22/2022	\$71.94	\$72.44	-	-0.69%	-2.67%	-3.00%	-3.33%	2.64%	1.75 *	1.74 *
4/25/2022	\$73.27	\$71.94	-	1.83%	0.53%	2.14%	2.01%	-0.18%	-0.12	-0.12
4/26/2022	\$69.45	\$73.27	-	-5.35%	-2.87%	-3.91%	-4.20%	-1.15%	-0.76	-0.76
4/27/2022	\$68.66	\$69.45	-	-1.14%	0.13%	0.28%	0.21%	-1.36%	-0.90	-0.90
4/28/2022	\$71.66	\$68.66	-	4.28%	2.27%	4.09%	4.12%	0.16%	0.10	0.10
4/29/2022	\$76.59	\$71.66	-	6.65%	-3.41%	-4.14%	-4.51%	11.16%	7.40 ***	7.33 ***
5/2/2022	\$74.47	\$76.59	-	-2.81%	0.59%	1.72%	1.63%	-4.43%	-2.94 ***	-2.93 ***
5/3/2022	\$72.82	\$74.47	-	-2.24%	0.51%	-0.88%	-0.80%	-1.44%	-0.96	-0.95
5/4/2022	\$75.79	\$72.82	-	4.00%	2.76%	3.06%	3.26%	0.74%	0.49	0.49
5/5/2022	\$70.19	\$75.79	-	-7.68%	-3.70%	-6.12%	-6.40%	-1.28%	-0.85	-0.84
5/6/2022	\$68.54	\$70.19	-	-2.38%	-0.84%	-3.13%	-3.12%	0.74%	0.49	0.49
5/9/2022	\$65.93	\$68.54	-	-3.88%	-3.61%	-5.83%	-6.11%	2.23%	1.48	1.46
5/10/2022	\$52.25	\$65.93	-	-23.26%	0.13%	1.53%	1.37%	-24.63%	-16.33 ***	-16.28 ***
5/11/2022	\$48.07	\$52.25	-	-8.34%	-1.73%	-3.87%	-3.96%	-4.37%	-2.90 ***	-2.88 ***
5/12/2022	\$52.73	\$48.07	-	9.25%	0.15%	1.00%	0.88%	8.37%	5.55 ***	5.54 ***
5/13/2022	\$53.34	\$52.73	-	1.15%	2.66%	5.01%	5.05%	-3.90%	-2.59 ***	-2.56 **
5/16/2022	\$50.42	\$53.34	-	-5.63%	-0.47%	-2.63%	-2.59%	-3.04%	-2.01 **	-2.00 **
5/17/2022	\$49.90	\$50.42	-	-1.04%	2.03%	1.67%	1.84%	-2.88%	-1.91 *	-1.90 *
5/18/2022	\$46.98	\$49.90	-	-6.03%	-3.84%	-4.37%	-4.80%	-1.23%	-0.81	-0.80
5/19/2022	\$48.77	\$46.98	-	3.74%	-0.21%	1.94%	1.69%	2.05%	1.36	1.35
5/20/2022	\$48.48	\$48.77	-	-0.60%	0.00%	1.39%	1.22%	-1.81%	-1.20	-1.20
5/23/2022	\$48.53	\$48.48	-	0.10%	1.63%	1.04%	1.18%	-1.08%	-0.72	-0.71
5/24/2022	\$46.54	\$48.53	-	-4.19%	-1.07%	-3.20%	-3.22%	-0.96%	-0.64	-0.64

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
5/25/2022	\$47.79	\$46.54	-	2.65%	1.11%	3.01%	2.92%	-0.27%	-0.18	-0.18
5/26/2022	\$47.70	\$47.79	-	-0.19%	1.96%	2.27%	2.38%	-2.57%	-1.70 *	-1.70 *
5/27/2022	\$50.45	\$47.70	-	5.61%	2.42%	3.58%	3.68%	1.93%	1.28	1.27
5/31/2022	\$49.54	\$50.45	-	-1.82%	-0.70%	-2.00%	-2.05%	0.23%	0.15	0.15
6/1/2022	\$50.26	\$49.54	-	1.44%	-0.70%	0.53%	0.30%	1.15%	0.76	0.76
6/2/2022	\$54.73	\$50.26	-	8.52%	2.01%	4.67%	4.61%	3.91%	2.59 ***	2.57 **
6/3/2022	\$52.47	\$54.73	-	-4.22%	-1.55%	-2.41%	-2.58%	-1.64%	-1.09	-1.08
6/6/2022	\$53.01	\$52.47	-	1.02%	0.30%	0.00%	-0.02%	1.04%	0.69	0.69
6/7/2022	\$54.01	\$53.01	-	1.87%	0.98%	1.62%	1.61%	0.26%	0.17	0.17
6/8/2022	\$54.25	\$54.01	-	0.44%	-1.05%	-0.63%	-0.84%	1.29%	0.85	0.85
6/9/2022	\$52.12	\$54.25	-	-4.01%	-2.39%	-2.53%	-2.84%	-1.17%	-0.77	-0.77
6/10/2022	\$49.35	\$52.12	-	-5.46%	-2.86%	-4.72%	-4.95%	-0.51%	-0.34	-0.34
6/13/2022	\$45.91	\$49.35	-	-7.23%	-4.15%	-6.05%	-6.42%	-0.80%	-0.53	-0.53
6/14/2022	\$45.58	\$45.91	-	-0.72%	-0.35%	0.69%	0.50%	-1.23%	-0.81	-0.81
6/15/2022	\$46.45	\$45.58	-	1.89%	1.49%	2.59%	2.59%	-0.70%	-0.46	-0.46
6/16/2022	\$44.01	\$46.45	-	-5.40%	-3.48%	-4.74%	-5.08%	-0.31%	-0.21	-0.21
6/17/2022	\$46.53	\$44.01	-	5.57%	0.40%	2.07%	1.92%	3.65%	2.42 **	2.41 **
6/21/2022	\$46.85	\$46.53	-	0.69%	2.23%	1.86%	2.05%	-1.37%	-0.91	-0.90
6/22/2022	\$46.94	\$46.85	-	0.19%	-0.22%	0.20%	0.08%	0.11%	0.07	0.07
6/23/2022	\$50.41	\$46.94	-	7.13%	0.91%	3.75%	3.57%	3.56%	2.36 **	2.34 **
6/24/2022	\$52.72	\$50.41	-	4.48%	2.94%	4.37%	4.50%	-0.02%	-0.01	-0.01
6/27/2022	\$51.72	\$52.72	-	-1.92%	-0.21%	-1.93%	-1.90%	-0.02%	-0.01	-0.01
6/28/2022	\$49.41	\$51.72	-	-4.57%	-1.89%	-3.89%	-4.02%	-0.55%	-0.37	-0.36
6/29/2022	\$49.16	\$49.41	-	-0.51%	-0.27%	0.29%	0.15%	-0.65%	-0.43	-0.43
6/30/2022	\$47.84	\$49.16	\$0.03	-2.66%	-0.90%	-1.63%	-1.74%	-0.92%	-0.61	-0.61
7/1/2022	\$49.46	\$47.84	-	3.33%	1.09%	1.61%	1.61%	1.72%	1.14	1.14
7/5/2022	\$51.26	\$49.46	-	3.57%	0.20%	2.77%	2.53%	1.04%	0.69	0.69
7/6/2022	\$50.29	\$51.26	-	-1.91%	0.07%	0.05%	-0.01%	-1.90%	-1.26	-1.26
7/7/2022	\$50.53	\$50.29	-	0.48%	1.68%	2.07%	2.15%	-1.67%	-1.11	-1.10
7/8/2022	\$50.15	\$50.53	-	-0.75%	-0.08%	-0.31%	-0.37%	-0.39%	-0.26	-0.26
7/11/2022	\$48.40	\$50.15	-	-3.55%	-1.32%	-1.77%	-1.94%	-1.61%	-1.07	-1.06
7/12/2022	\$47.11	\$48.40	-	-2.70%	-0.81%	-3.97%	-3.89%	1.19%	0.79	0.78
7/13/2022	\$45.52	\$47.11	-	-3.43%	-0.34%	-0.96%	-1.03%	-2.41%	-1.60	-1.59
7/14/2022	\$44.78	\$45.52	-	-1.64%	-0.56%	-0.92%	-1.02%	-0.62%	-0.41	-0.41
7/15/2022	\$46.20	\$44.78	-	3.12%	1.84%	2.57%	2.63%	0.49%	0.32	0.32

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	t-statistic	Newey-West t-statistic
7/18/2022	\$46.09	\$46.20	-	-0.24%	-0.55%	-0.71%	-0.82%	0.58%	0.39	0.39
7/19/2022	\$47.75	\$46.09	-	3.54%	2.70%	2.97%	3.17%	0.37%	0.25	0.25
7/20/2022	\$50.00	\$47.75	-	4.60%	0.78%	3.38%	3.20%	1.40%	0.93	0.92
7/21/2022	\$50.69	\$50.00	-	1.37%	0.93%	1.80%	1.77%	-0.40%	-0.26	-0.26
7/22/2022	\$50.07	\$50.69	-	-1.23%	-1.05%	-1.84%	-1.96%	0.73%	0.49	0.48
7/25/2022	\$47.82	\$50.07	-	-4.60%	0.20%	-1.34%	-1.28%	-3.32%	-2.20 **	-2.19 **
7/26/2022	\$46.37	\$47.82	-	-3.08%	-1.19%	-3.29%	-3.33%	0.25%	0.17	0.17
7/27/2022	\$47.55	\$46.37	-	2.51%	2.50%	4.45%	4.50%	-1.99%	-1.32	-1.31
7/28/2022	\$40.24	\$47.55	-	-16.69%	1.24%	1.95%	1.96%	-18.65%	-12.36 ***	-12.34 ***
7/29/2022	\$40.15	\$40.24	-	-0.22%	1.33%	1.13%	1.21%	-1.43%	-0.95	-0.95
8/1/2022	\$40.42	\$40.15	-	0.67%	-0.22%	0.04%	-0.07%	0.74%	0.49	0.49
8/2/2022	\$39.82	\$40.42	-	-1.50%	-0.53%	0.26%	0.08%	-1.57%	-1.04	-1.04
8/3/2022	\$40.31	\$39.82	-	1.22%	1.49%	3.20%	3.16%	-1.94%	-1.28	-1.28
8/4/2022	\$38.70	\$40.31	-	-4.08%	-0.05%	0.13%	0.04%	-4.12%	-2.73 ***	-2.73 ***
8/5/2022	\$38.95	\$38.70	-	0.64%	-0.04%	0.31%	0.21%	0.43%	0.29	0.29
8/8/2022	\$40.72	\$38.95	-	4.44%	0.12%	-0.05%	-0.09%	4.53%	3.01 ***	3.00 ***
8/9/2022	\$38.85	\$40.72	-	-4.70%	-0.64%	-1.45%	-1.52%	-3.18%	-2.11 **	-2.10 **
8/10/2022	\$40.43	\$38.85	-	3.99%	2.24%	3.92%	3.96%	0.02%	0.02	0.01
8/11/2022	\$40.61	\$40.43	-	0.44%	-0.02%	-1.31%	-1.29%	1.73%	1.15	1.15
8/12/2022	\$42.17	\$40.61	-	3.77%	1.67%	2.05%	2.13%	1.64%	1.09	1.08
8/15/2022	\$42.41	\$42.17	-	0.57%	0.28%	0.51%	0.46%	0.11%	0.07	0.07
8/16/2022	\$41.81	\$42.41	-	-1.42%	0.19%	-0.72%	-0.70%	-0.72%	-0.48	-0.48
8/17/2022	\$40.60	\$41.81	-	-2.94%	-0.92%	-1.71%	-1.82%	-1.11%	-0.74	-0.74
8/18/2022	\$40.46	\$40.60	-	-0.35%	0.27%	-0.09%	-0.10%	-0.24%	-0.16	-0.16
8/19/2022	\$39.04	\$40.46	-	-3.57%	-1.47%	-2.33%	-2.49%	-1.08%	-0.72	-0.72
8/22/2022	\$37.42	\$39.04	-	-4.24%	-2.05%	-2.86%	-3.09%	-1.15%	-0.76	-0.76
8/23/2022	\$36.21	\$37.42	-	-3.29%	-0.07%	-0.05%	-0.13%	-3.16%	-2.10 **	-2.09 **
8/24/2022	\$36.57	\$36.21	-	0.99%	0.39%	0.69%	0.64%	0.35%	0.23	0.23
8/25/2022	\$37.08	\$36.57	-	1.38%	1.41%	0.88%	0.99%	0.39%	0.26	0.26
8/26/2022	\$36.24	\$37.08	-	-2.29%	-3.24%	-3.96%	-4.31%	2.02%	1.34	1.33
8/29/2022	\$36.27	\$36.24	-	0.08%	-0.65%	-1.46%	-1.54%	1.63%	1.08	1.08
8/30/2022	\$36.46	\$36.27	-	0.52%	-1.15%	-0.15%	-0.41%	0.94%	0.62	0.62
8/31/2022	\$36.61	\$36.46	-	0.41%	-0.72%	-0.77%	-0.91%	1.32%	0.87	0.87
9/1/2022	\$36.78	\$36.61	-	0.46%	-0.11%	-1.54%	-1.52%	1.98%	1.31	1.31
9/2/2022	\$35.66	\$36.78	-	-3.09%	-0.86%	-0.65%	-0.82%	-2.27%	-1.51	-1.50

**Exhibit-13****Pegasystems Common Stock Event Study Results**

Examination Period: 16 June 2020 through 15 September 2022

Date	PEGA Closing Price	PEGA Prior Day Closing Price	PEGA Dividend	PEGA Logarithmic Return	Market Index Logarithmic Return	Sector Index Logarithmic Return	PEGA Explained Return	PEGA Residual Return	<i>t</i> -statistic	Newey-West <i>t</i> -statistic
9/6/2022	\$35.35	\$35.66	-	-0.87%	-0.49%	-0.78%	-0.88%	0.01%	0.01	0.01
9/7/2022	\$36.00	\$35.35	-	1.82%	1.81%	2.19%	2.28%	-0.46%	-0.30	-0.30
9/8/2022	\$38.24	\$36.00	-	6.04%	0.74%	1.35%	1.31%	4.72%	3.13 ***	3.13 ***
9/9/2022	\$40.03	\$38.24	-	4.57%	1.65%	2.85%	2.87%	1.71%	1.13	1.13
9/12/2022	\$41.67	\$40.03	-	4.02%	1.07%	1.29%	1.32%	2.70%	1.79 *	1.78 *
9/13/2022	\$39.80	\$41.67	-	-4.59%	-4.14%	-4.89%	-5.34%	0.75%	0.49	0.49
9/14/2022	\$39.95	\$39.80	-	0.38%	0.40%	0.08%	0.08%	0.30%	0.20	0.20
9/15/2022	\$40.24	\$39.95	-	0.72%	-1.03%	-3.47%	-3.47%	4.20%	2.78 ***	2.77 ***

**Sources:** CRSP, S&P, and computations performed by Crowninshield Financial Research, Inc.**Note:**

"\*\*\*" indicates statistical significance at the 99% confidence level.

"\*\*\*" indicates statistical significance at the 95% confidence level.

"\*" indicates statistical significance at the 90% confidence level.